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ABSTRACT

A research project was designed to determine whether eleventh and twelfth grade students of carpentry possess the reading skills necessary to comprehend instructional materials used in the field and classroom. A sample population of ninety-two students from twenty-seven school districts was selected for testing from three facilities. Three hundred thirteen passages were randomly selected from carpentry literature and clozed for testing. The test was scored according to frustrational, instructional, and independent levels of reading ability. The range of readability of carpentry literature was first half fifth grade to college graduate, with the mean being at the ninth grade level. Student reading ability was tested at low to middle eighth grade. At that level none of the students scored at the frustrational level. Sixty-five percent scored at the high instructional, low independent levels. Conclusions included that carpentry literature readability is bimodal, with a significant portion at levels beyond the abilities of its intended users, and at best, eleventh and twelfth grade carpentry students read carpentry literature at the instruction level, requiring supervision of translation to skill, or remediation to upgrade their average abilities. Recommendations included establishing a content reading skills assessment and training procedure for carpentry students. The "Comprehensive Examination in Carpentry" used in the study is appended. (BL)

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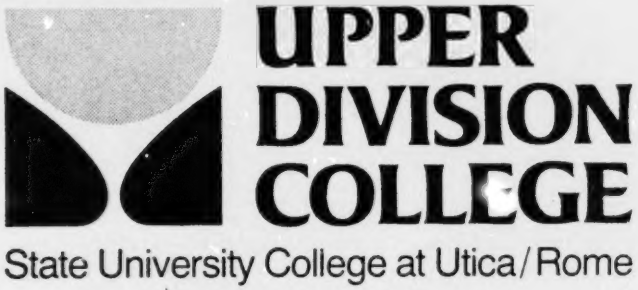

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CARPENTRY LITERATURE

READABILITY VS READING ABILITY

BY

L. J. THORNTON

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STATE UNIVERSITY COLLEGE, UTICA/ROME

UTICA, NEW YORK

RELATIONSHIP OF READABILITY OF CARPENTRY MATERIAL INSTALLATION INSTRUCTIONS AND CARPENTRY TEXTBOOKS TO READING ABILITY OF HIGH SCHOOL CARPENTRY STUDENTS

DEPARTMENT OF VOCATIONAL-TECHNICAL EDUCATION

BY
L. J. THORNTON

DECEMBER 16, 1977

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CHAPTER I

INTRODUCTION

Statement of Problem

This research is to be a two-part examination of the level of readability, by grade, of literature used by carpenters in the field and text materials used by students in the classroom, in comparison to the reading ability of 11th and 12th grade high school carpentry students as examined in the context of field and textbook carpentry literature.

General Purpose

The purpose of the research is to determine whether 11th and 12th grade carpentry students possess the reading skills necessary to comprehend carpentry materials installation instructions and classroom carpentry literature.

Sub-problems

1. How diverse are the readability levels of carpentry materials installation instructions?
2. What is the average reading level necessary to understand the literature?

3. At what readability level are the textbooks, used in 11th and 12th year carpentry classes, written?

4. What method can be used to determine the ability or inability of students to comprehend content material other than the predictive standardized diagnostic reading tests which are not content oriented?

Background and Significance

The inability of students and graduates at all levels to read is a subject about which there is currently a great deal of discussion. Educators are faced with reading levels of students being sufficiently low to preclude their ability to cope with subject matter that requires this skill. Problems relating to reading skills are compounded beyond the schools, for example, when the student enters his chosen field of work. The problem exists for carpentry students emerging into the world of work as well as those students who choose other fields generally considered to involve more reading than the skilled trades.

Although not quantified, improper installation is a significant factor in the failure of materials in performance. It is evident that a possible explanation of repeated improper installation could be lack of or shortage of those carpentry skills required for proper installations. However, in all areas of carpentry construction, the experience of the carpentry employee is closely scrutinized at entry and subsequent supervision of performance is structured according to entry skills and procedur-

al skill development under that supervision.

General contractors and carpentry contractors measure the skill level of employees according to length of time at skill level, utilizing instruments of measurement provided by the United Brotherhood of Carpenters and Joiners of America, the Associated General Contractors of America, Inc., and the National Association of Home Builders of the United States, in accordance with the Bureau of Apprenticeship and Training, U.S. Department of Labor. Determinations of rate-per-hour and expected performance are made according to those traditional and clearly defined descriptions, which are essentially tenure.

The controls for skills-to-task matching problem lie with the hiring practices of the employer and the quality of immediate supervision of performance. It is not a concern of this study, except to point out that this area is the predominant one tested at entry and reclassification. That is, hands-on skill level is the single criterion for employment and continuation of employment. When there is a breakdown, manifested by product failure, the skill level of the performers is what is considered. In systemic failure, manifested by a multiple of product failures, fault is examined in skills context, then in supervision, then in contracting credentials. Additional evidence of this fault-procedure: examination-procedure is found in contract litigation, which heavily relies on skills-tenure examination of the contracting defendants.

One skill which is not considered at entry level or at

subsequent reclassification times of carpentry employment is the reading skill possessed by the employee. The National Apprenticeship and Training Standards contain no reference to or program of reading skill assessment. Its preface suggests "...the local joint committee should consult local public vocational school authorities for assistance in locating suitable text material and teaching aids to fit local needs."[1] In its statement of purpose, the National Committee refers to "techniques and standards of workmanship that are of vital economic importance."[2] (See Appendix III for the complete text of "Preface" and "Purpose of National Standards.")

Historically, most carpenters proceeded through the apprentice program into journeyman status in their trade. During the apprentice period, translation of materials instructions was a unilateral function of supervision. For those in current apprentice programs, this continues to be true. However, few of the students in high school carpentry programs will participate in apprenticeship. In discussions with the teachers of the sample population for this study, it was concluded that a fair estimate would be about ten per cent will proceed to apprenticeship. The others will, most likely, seek jobs. The rigid structure of union carpentry and apprenticeship does not exist outside union contracting, in non-union carpentry. There is less unilateral translation from tenured supervisors. It is likely, therefore, that the carpenter will be confronted with the need to do his own translation of materials installation instructions at significantly

lower levels of experience. Does he possess the skill?

The National Apprenticeship and Training Standards "Preface" and "Statement of Purpose" refer to the consultation of the vocational school authorities for text materials and teaching aids.[3] Do these authorities consider reading ability, either in terms of capability of text translation or materials installation instructions?

In all the skilled trades, ther is a language peculiar to each trade and a language acquisition level of persons within the trade related to performance expectation. In instance of failure, assuming the proper skills, is the problem one of vocabulary in terms of conversancy in the trades, the accepting of verbal instructions and interpreting those instructions, translating into application of literature to task? In the rigid system of supervision found in union carpentry and apprenticeship, perhaps, but less likely in the less stratified carpentry employment situations. The answer lies in the quality and amount of supervision. If the supervision is such that each step in any procedure is interpreted for the employee by someone who can read the literature, the problem remains one of verbal comprehension and skill. If the ratio of supervision to workers is such that this interpretation of literature is not possible, the problem then becomes one of the readability of the literature and the reading ability of the user. It is the second situation that is critical to 90% of the students of carpentry who emerge into carpentry employment, but the first that is thought to be oper-

ational. Supposedly, each skill level passes to the next, in a unilateral and downward progression, the information necessary to complete the task.

The trades vocabulary question is not a part of the study, except to the extent of control in regards its effect in determining reading ability and readability, a problem discussed more fully in the section pertaining to research measurement and design.

Materials Installation Instructions

Building products manufacturers provide a vast amount of materials for the carpenter, both in volume and variety. These range from "rough" materials, such as beams, framing lumber, and structural products, to interior/exterior finish products and appliances, such as, windows, doors, etc., with attendant hardware.

Except for most framing products, building materials are accompanied by installation literature. The literature describes the rough carpentry necessary for installation, such as, rough openings for windows, surface preparation for roofing and exterior siding and the like. It also procedurally instructs the preferred ways of installing the product, once the preliminaries are accomplished.

The literature is of a wide variety of degree of difficulty according to the task, the amount of technical manufacturer language, the amount of trades language, the amount of lay description, the complexity of sentence structure, use of diagram/illus-

tration, and the attendant language to diagram ratio. (See Figure 1 for representative sample of materials installation instruction, supplied by the manufacturer.)

Projects Instructional Literature

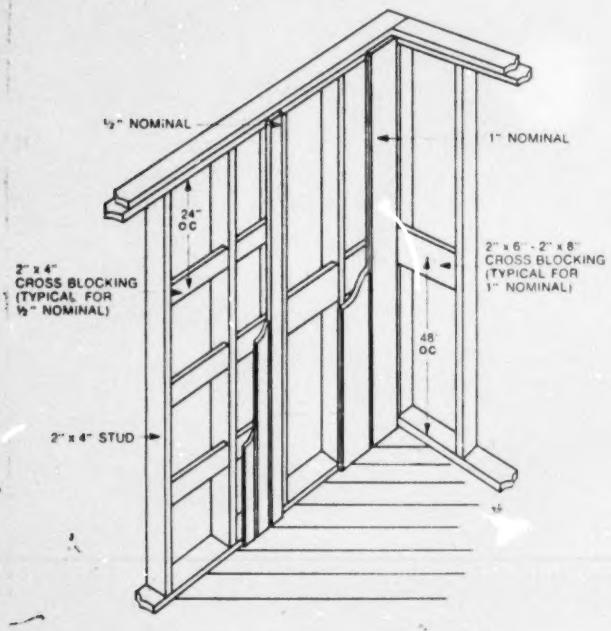
In addition to the specific instructions for installation of products, there is a vast amount of projects oriented literature. Some of it is supplied by manufacturers of building products to stimulate market for their products; some by the government as a service for consumers; some by tool manufacturers to stimulate the sales of their products. It differs from products literature in that its orientation is toward a more general use, less likely to be used only by a skilled carpenter, supposedly useful for the homeowner, farmer, non-trained handyman category of user. Generally, project literature does not refer to the installation of a specific product, but instructs procedures for accomplishing the building of some project, with or without reference to applicable materials. (See Figure 2 for a sample of projects literature.)

Classroom Instructional Literature

Three categories of instructional materials are used in the carpentry classroom: (1) textbooks, including student manuals in the modular systems; (2) teacher developed handouts, usually a basic concept illustration; (3) building plans and blueprints, real or facsimile. A listing of the textbooks used in this study

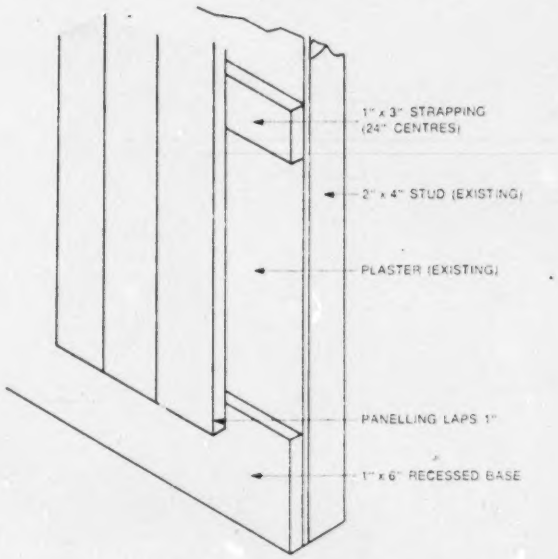
APPLICATION

In addition to proper nails and nailing techniques, a sound nailing surface is important for both new construction and remodelling.


½" NOMINAL
1" NOMINAL
24" OC
2" x 4" CROSS BLOCKING (TYPICAL FOR ½" NOMINAL)
2" x 6" - 2" x 8" CROSS BLOCKING (TYPICAL FOR 1" NOMINAL)
48" OC
2" x 4" STUD

PANELLING APPLIED TO WALL FRAME

When applying panelling to an unfinished frame wall, 2" x 4" cross blocking between the wall studs provides a solid nailing surface. It is a good technique to turn the cross blocking so that the 4-inch surface is face-outwards. This provides a larger nailing surface and easy passage for electrical wiring. Spacing of cross blocking varies with the thickness of the panelling. For 1-inch panelling, 48-inch intervals are recommended. For ½-inch panelling, blocking should be set at 24-inch intervals. Extra care should be taken in aligning the first panel: do not rely on the adjacent wall to be plumb at the corner. Once the first panel has been nailed accurately in place, the other panels will align themselves.



PANELLING APPLIED OVER PLASTER

When applying panelling over an existing plaster wall, the area to be panelled should be strapped with a series of 1" x 3" furring strips set horizontally at 24-inch centres. As illustrated, a 1" x 6" strip at the floor level creates a recessed baseboard. In applying the strapping, use nails of sufficient length to penetrate the wall plaster and anchor firmly in the wall studs. The top length of strapping should be set at ceiling height. Accurate alignment of the first piece of panelling will ensure correct alignment of the panels to follow.

Plaster ceilings can be panelled using a similar technique. When applying ½-inch thick panelling, use furring strips set at 16-inch centres; for 1-inch panelling, set furring strips at 24-inch centres.

Figure 1: Western Red Cedar Paneling, Council of Forest Industries, Vancouver, B.C., Canada.

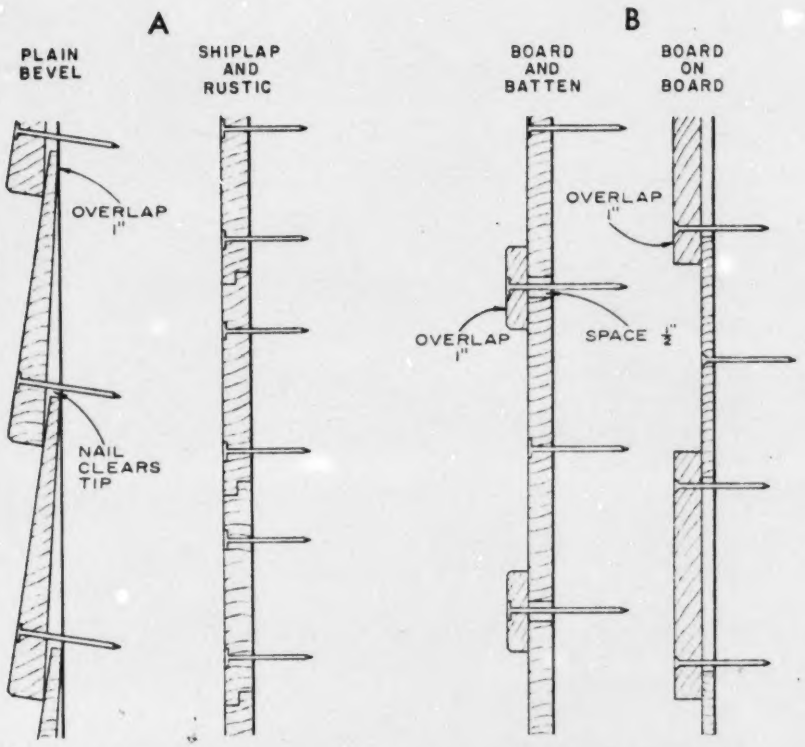


Figure 1.—Patterns of wood siding and recommended nailing practices. *A*, horizontal application, and *B*, vertical application.

The kind of siding chosen will depend on where the house is built, its price range, and the architectural effect wanted. A range of quality in lumber is available, from clear, smooth edge grained to rough, flat grained with knots and other characteristics that should be given special finishing treatments in accord with the effects wanted.

Paints last longer on edge-grained softwoods of low density that are low in swelling than on dense flat grained. Such flat-grained boards are better left rough sawn, and finished with a stain.

In painting flat-grained surfaces with broad bands of summerwood, special care should be given in selecting high-quality nonporous primers and topcoats that will protect the wood surface from excessive wetting with moisture (dew and rain).

Any wood surfaces such as those of plywood and fiberboards that are overlaid with resin-treated paper are excellent for painting. The overlay serves as a stabilizer against swelling from moisture.

Figure 2: Wood-siding--Installing, Finishing, Maintaining; Home and Garden Bulletin No. 203, U.S. Dept. of Agriculture.

and illustrative of those used most carpentry classes is contained in Appendix IV.

Teacher developed handouts (See Figure 3) contained very little text, if any, thus were excluded from consideration in this study. Real and facsimile blue-prints were also excluded from consideration.

Since there are controls available to the carpentry employer in the assessment of the skill level of the employee, it is not useful to correlate these skills phenomena with reading ability for the purpose of arriving at a level of competency based upon reading versus skill. It would, however, be of service, and it is the purpose of this research, to determine: the range of reading skills of 11th and 12th grade carpentry students, based upon materials installation instructions, project instructional literature, and classroom instructional literature; the readability of installation instructional and project instructional materials, according to readability criteria controlled for effect of simple conversancy in the trades; and similar analysis of materials used in the classroom to instruct potential carpentry employees.

Definition of Terms

The following words and phrases are defined to operationalize them in the context of this study. They may have more general or more explicit meanings in normal usage, but what follows is the contextual sense that applies to their use herein.

Area School. A school which receives students from other

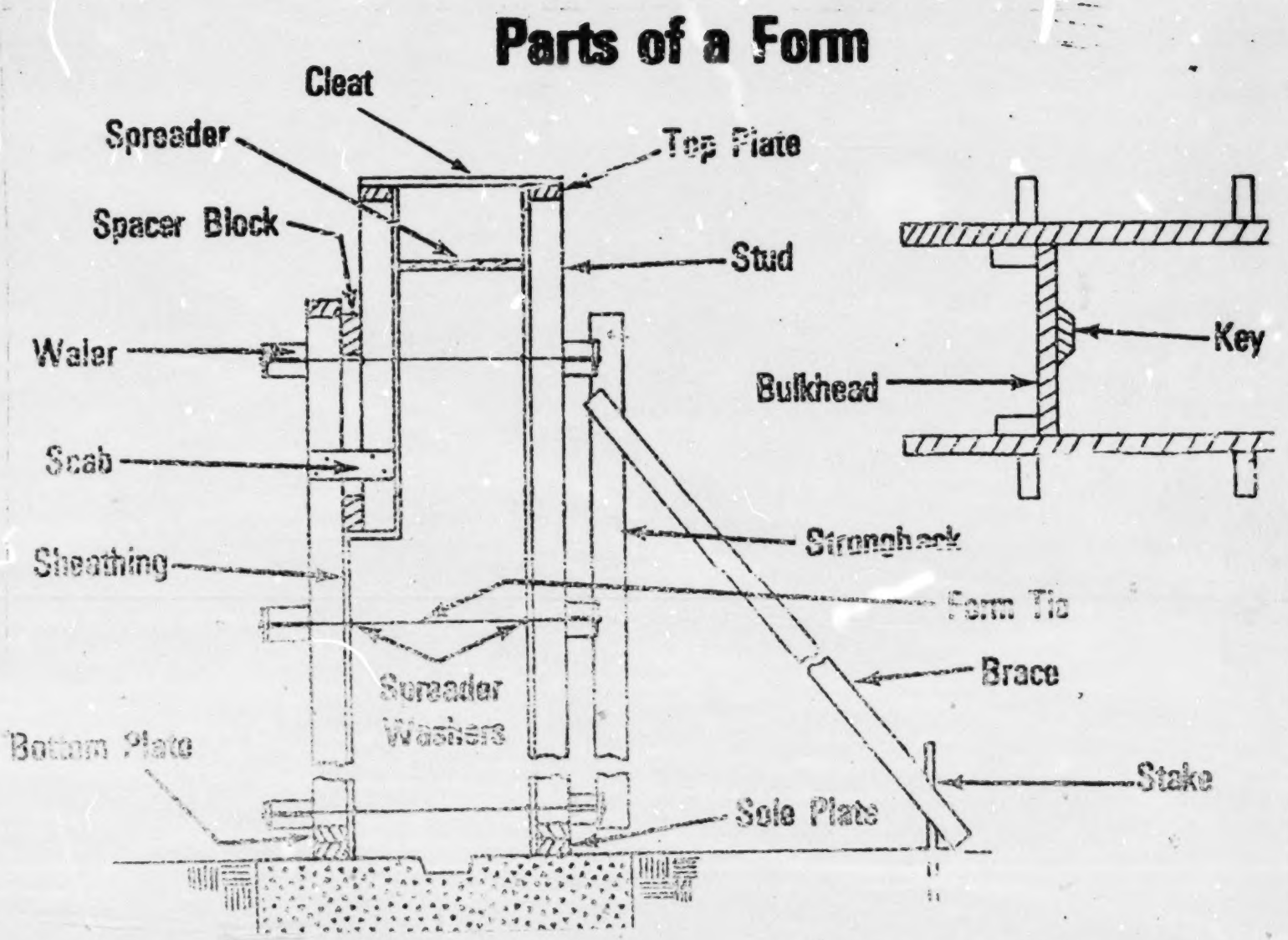


Figure 3: Teacher-developed classroom handout literature. Source unknown.

schools for special subjects, notwithstanding school district lines, based upon a geographical determination of service in conjunction with the special subjects offered.

Comprehensive High School. A school within a district which receives students from other schools within that district for the purpose of special studies in vocational subjects.

Conversancy. The quality or state of being conversant; having a verbal understanding of words or phrases, but not necessarily able to recognize them written. Able to recognize and use the word or phrase when spoken, but not an indicator of whether the word or phrase would be recognized in a reading situation.

High School Carpentry Students. Students in the last two years of laboratory carpentry, consisting of outside building projects, regardless of whether or not the students participated in a previous carpentry theory class. These are normally 11th and 12th grade students with the exception of ungraded veterans and ungraded special education students.

Reading Ability. The skills the reader must possess in order to comprehend a piece of literature, measured by the relative in-school grade level at which those skills would have been mastered.

Reading Comprehension. Ability to understand the written word, measured at three levels: independent or total understanding without interpretation; instructional or requiring some interpretation, but able to translate with some assistance; and frustrational or unable to comprehend the material, not in possession of the skills necessary to translate the literature.

Reading Level. The level at which a piece of literature is written in terms of the skills the reader must possess in order to comprehend that literature, measured by the relative in-school grade level at which those skills would have been mastered.

Limitations of The Study

During the preliminary considerations for this study, certain items were explored for possible inclusion which had to be excluded due to sampling procedures, time available for the research, data availability, and design limitation.

Tool manufacturer instructional literature was originally considered, but subsequent to preliminary surveys, it was decided to excluded this material because it is so diverse, testing would have had to be protracted beyond the limits imposed by attention span and time allowable away from classroom requirements.

Teacher developed literature was found to be primarily schematic or illustrative, nearly devoid of text, thus it was excluded. It is not the intended or proposed purpose of this study to critically analyze operating procedures, thus the exclusion of this material does not detract from the intent and purpose of the study. It cannot be assessed for readability; it was excluded.

Initial plans called for the testing of students in a program under MDTA or CETA, but neither of those have carpentry students of a comparable level to those being considered herein.

The testing of the students was to include clozed tests of

three kinds: diagram assisted, multiple choice, and raw cloze. This would have extended the testing time to limits beyond the available time allowed for in the sampling agreements with the teaching facilities.

A comparison of the diagnostic reading levels, on a student-by-student basis, would have been included, but to protect the rights of privacy of the students and recognizing the confidential nature of the information, none of the students were identified. Therefore, it was impossible to compare the results between the diagnostics and the performance of the students on the cloze tests.

Diagnostic reading scores were available from only one of the testing facilities, for approximately one-third of the sample. These were scores of the participants of the study, but not identified student-by-student. However, since only one of the facilities had such scores, a total sample comparison of the diagnostic scores to test results was not possible.

Instrumentation in this study is an extraction from another segment of the discipline, primarily used in elementary reading analysis. Part of the study is to examine its validity, as checked by a secondary measure in assessing readability, but at best, the results could elicit theory, of utility in continued experimentation, not a rule to be applied, until it is validated by extensive research.

The materials installation instructions and project instructional literature were extracted from the files of one contractor, representing an accumulation of approximately eight years. This

would pose three possible biases:

(1) Regional bias - materials on file would generally reflect the kinds of carpentry projects occurring within the geographical limits of the contractor;

(2) Business focus bias - the materials would generally represent the focus of that contractor within the parameters of expertise, general types of projects solicited, and the individual interests of the contractor;

(3) Economic bias - the materials would also represent literature solicited in accordance with the economic base of the contractor's operation, that is, capitalization, equipment, number of employees, etc.

The time frame of the study precluded soliciting a broader base of literature for analysis for two reasons:

(1) Although computerization of the readabilitiy formulas used is possible, an applicable terminal was not available. Thus, the amount of literature analyzed was limited by time available for the mechanics of analysis;

(2) Materials manufacturers will supply their literature on request, but the time frame did not allow for extensive solicitation.

The Hawthorne Effect, subject's awareness of an experimental situation, may dilute the results, as may the novelty effect.

Basic Assumptions

It is required that carpentry students possess the skills

necessary to read literature relating to the performance of carpentry tasks.

There is information contained in carpentry literature necessary for the performance of carpentry tasks and available through no other means than translation from text.

It is a function of education, whether academic or vocational technical, to ascertain that the carpentry student's reading ability is commensurate with the level of literature pertaining to the hands-on skills taught.

Readability of carpentry literature can be measured in terms of reading skills necessary to peruse said literature.

Summary

There is a substantial amount of literature which must be used by carpenters in order to practice their trade. This literature is made up of materials installation instructions and project assembly/installation instructions for the practitioner and classroom instructional literature for the student of carpentry.

Although there are procedures for assessing the hands-on skills of entry level carpenters and the progressive skill development of tenured carpenters, there has not been consideration of the reading ability of carpentry students in the context of the readability of materials and projects installations instructions or classroom instructional literature.

Procedures exist for the analysis of the readability of materials installation instructional literature, project instructions

and classroom instructional literature. The reading level of these materials can be determined and matched to the reading skill of those expected to utilize them. Furthermore, the reading ability of students of carpentry can be assessed in terms of the actual literature they will be expected to use. These considerations are necessary to adequately prepare students to practice their trade.

It is, therefore, the purpose of this study to determine the range of readability levels of materials installation instructional literature, project instructional literature, and classroom instructional literature, within the defined limitations; measure the ability of 11th and 12th grade carpentry students to read the three kinds of literature, using actual literature for assessment; and establish a relationship in terms of the mean readability levels, mean reading ability levels, and the modality of levels of skills necessary to utilize the respective literatures.

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[1]National Apprenticeship And Training Standards, National Joint Carpentry Apprenticeship And Training Committee, page vii.

[2]Ibid., p. ix.

[3]Ibid., p. vii.

CHAPTER II

A REVIEW OF THE LITERATURE

The Problem

It has been estimated that one-third of the nation's youth leave school without obtaining sufficient reading skills to meet the demands of employment.[1] There are no areas in either the academic world of the world of work in which reading does not play a crucial role. Even at the lowest job entry level, a person has to be able to read and follow directions in order to complete simple tasks correctly, read and fill out forms and applications intelligently, etc. Whether he is following the sequence of steps in a job sheet or studying a text on constitution law, he must be able to understand and correctly interpret the printed word at whatever level of abstraction it is written.

Job analysis usually does not provide for an indication of the amount of reading necessary for the job, even at entry. Often there is simply a statement that the employee must be able to read and understand technical material pertaining to the job. In 1973, the Department of Manpower and Immigration of Saskatchewan, Canada, surveyed, by summary task statement, workers and supervisors in their various departments, to determine reading skills

levels. The results were published in the form of raw data without an attempt to ascertain levels of correlation between readability and reading ability of the tasks/workers investigated.[2]

The Canadian study was innovative, in that it included job descriptions below levels normally considered to require reading ability. Skilled and unskilled workers were included in the survey. Certainly, it was a limited investigation, not generalizable in content to other areas, but it did serve to identify a need for more and in-depth reading research of its kind.

The military in the United States was one of the first major employers to consider the import of reading ability as it applies to specific employment/placement criteria. Materials for use by cooks, mechanics, and supply clerks, were analyzed as to the reading tasks involved.[3] From this research, a "Table of General Reading Grade Levels of Skill Needed To Achieve Three Criterion Levels of Performance on Index Tests in Three Army Jobs" was developed.[4] It was one of the few examples of research which would provide for matching reading ability and readability.

Education has been more sensitive to the phenomena related to contextual analysis of readability, but it has been primarily confined to the issue of text desirability. Practically since inception, the basal reader has been related to grade level and, more recently, to level within grade level. In 1972 a study was conducted to determine the text level of readability in relation to the reading ability of students who would use the texts for secondary school courses in vocational education.[5] The correlation

studies done, however, have not evidenced the compatibility of reading ability and readability of unskilled, semi-skilled and skilled workers contextually to their respective practicing literatures.

Carpentry textbooks repeatedly refer the student of carpentry to the manufacturer's instructions. In Willis Wagner's Modern Carpentry:[6]

--(tools)--"Follow directions listed in the manufacturer's manual."[7]

--(mastics)--"Always follow directions of the manufacturer of the product being applied."[8]

--(shingles)--"Always study and follow the manufacturer's directions."[9]

--(tile)--"Be sure to follow the manufacturer's recommendation."[10]

--(sliding doors)--"Sliding door hardware for bypass doors is packaged complete with track hangars (rollers), floor guide screws and instructions for making the installation."[11]

--(cabinets)--"Manufacturers of cabinetwork provide detailed instructions for the installation of their products."[12]

After all these, and more, reminders to read manufacturer's installation literature, Wagner's only comment regarding the ability to read is, "Social studies and English should be included...to... be competent in reading, writing, and speaking."[13]

In another set of texts, the Delmar Series, developed in conjunction with the New York State Education Department, is found, "In most cases, the manufacturer of each kind of insulation

furnishes instructions for installing that particular kind of insulation. These directions should be carefully followed.[14]

"In some cases the manufacturer of frames (windows and doors) supplies specific instructions for assembling. These should be followed."[15]

"The learner should follow the directions for application as given by the manufacturer of the particular shingle."[16]

In 1975 a textbook and materials evaluation was performed by the Cornell Institute for Research and Development in Occupational Education in cooperation with the Bureau of Inservice Education, New York State Education Department.[17] Eighty-four teachers participated as a task force to evaluate seven categories of materials in this first of two volumes. The categories evaluated were automobile mechanics, building trades, business education, child care education, cosmetology, distributive education, and practical nursing.

All evaluation was done by classroom teachers, selected by the project staff. These teachers were invited to attend workshops and received training in the evaluation of instructional materials. Approximately twenty assessment instruments were used. First, individual teachers rated the material according to bias, accuracy, appropriateness, verbal and visual fluency and usefulness and versatility, arriving at a summary profile of the material. The evaluation concluded with an overall assessment, statement of accuracy rating, classroom use, training requirement, availability of consulting services to provide training for use, other valida-

tion done, and discipline or target areas for which the material might be appropriate. These data were contained in questionaire, the instrument developed with EDPA funds, Section 554, under contract with the Bureau of Inservice Education, New York State Department of Education, as revised, 1975.[18]

Following the initial questionnaire, a task force of three to five teachers completed a second instrument entitled, "Instructional Materials Assessment."[19] This questionnaire summarized the previous assessments and included a section of readability. One of three readability formulas was used to assess the written material: Dale-Chall, Fry, and Spache; each discussed later.

In the section entitled "Building Trades," some of the materials used by the sample population schools in this study were assessed. Those analyzed were: Modern Carpentry[21] Concrete Form Construction,[22] Framing, Sheathing, and Insulation,[23] Suggested Unit Course In Interior and Exterior Trim.[24] The Fry Readability Formula was used for their assessment regarding level of readability.

Readability

The problem in determining readability is to relate a given piece of literature to the grade level in school at which one would possess the skill to comprehend it. There are a number of existing formulas designed to provide an index of probable difficulty for readers.[25] Twenty-four readability formulas were considered, according to their direct applicability or adaptability. The most prominent, the Dale-Chall Method,[26] had to be rejected, because it

relies on a 3000 word list of hard words, not relevant to content material evaluation as would be necessary in this study.[27]

Studies attempting to add known context words to the Dale-Chall method[28] found that the addition nullified the results.[29] Holmquist (1968)[30] recalculated the Dale-Chall method, expanding the hard words list to 3102, using the Brown science list.[31] Crane (1963)[32] felt the single best predictors were words of three or more syllables and words beginning with D,G,H,L,M,S,T minus those beginning with A,I,O and abstract verbs.[33] The Farr-Jenkins-Paterson procedure[34] considered one-syllable words and average sentence length, but without interpretation.[35]

The Fog Index,[36] using a hard words list of those containing three or more syllables, determines grade level by multiplying .4 times the average sentence length plus the percentage of words with three or more syllables.[37] However, the formulas is vague in interpretation of sentence length.

Spache (1953) formula[38] uses word difficulty listing outside the original Dale List of 769 words, but the use of a list again precluded its use in this content study.

It was thought that one of the science adaptations might clue a carpentry usage, because of the mathematics inclusions. The four most prominent were considered: Jacobson (1961),[39] chemistry and physics; Coleman (1965),[40] Elley (1969),[41] and Shaw (1967),[42] general science, formulas. With the possible exception of Jacobson, each of these required vocabulary load to arrive at index, serving to examine verbal conversancy in disciplin

more than readability of literature. Jacobson did posit words-per-independent-clause and concentration of simplified mathematical terms, which are interesting as indices, but not useful here because of the mathematical emphasis.

One formula and one graph were selected for use. The Flesh Reading Ease Formula[43] compares the number of syllables per hundred words and the number of words per sentence to arrive at a reading ease measurement. The reading ease measurement translates to grade level according to a chart developed by the author.

The procedure requires the random selection of sample pieces of writing. A count is then taken of each word in the sample up to 100. Contractions, hyphonated words, letters and numbers count as single words. All the samples are then combined to arrive at an average of sentence length, following units of thought, rather than specific punctuation rules. Sentences involving conjunctions are not broken up. A count is taken of all the syllables in the samples, to arrive at the number of syllables per 100 words. The results are graphed on the Reading Ease Chart (See Figure 4) or subjected to the following calculations to arrive at Reading Ease:

R.E. Score = 206.835 minus (1.015 times number of words per sentence, plus .846 times number of syllables per hundred words.)

The resultant scores translate into grade level according to the following chart:

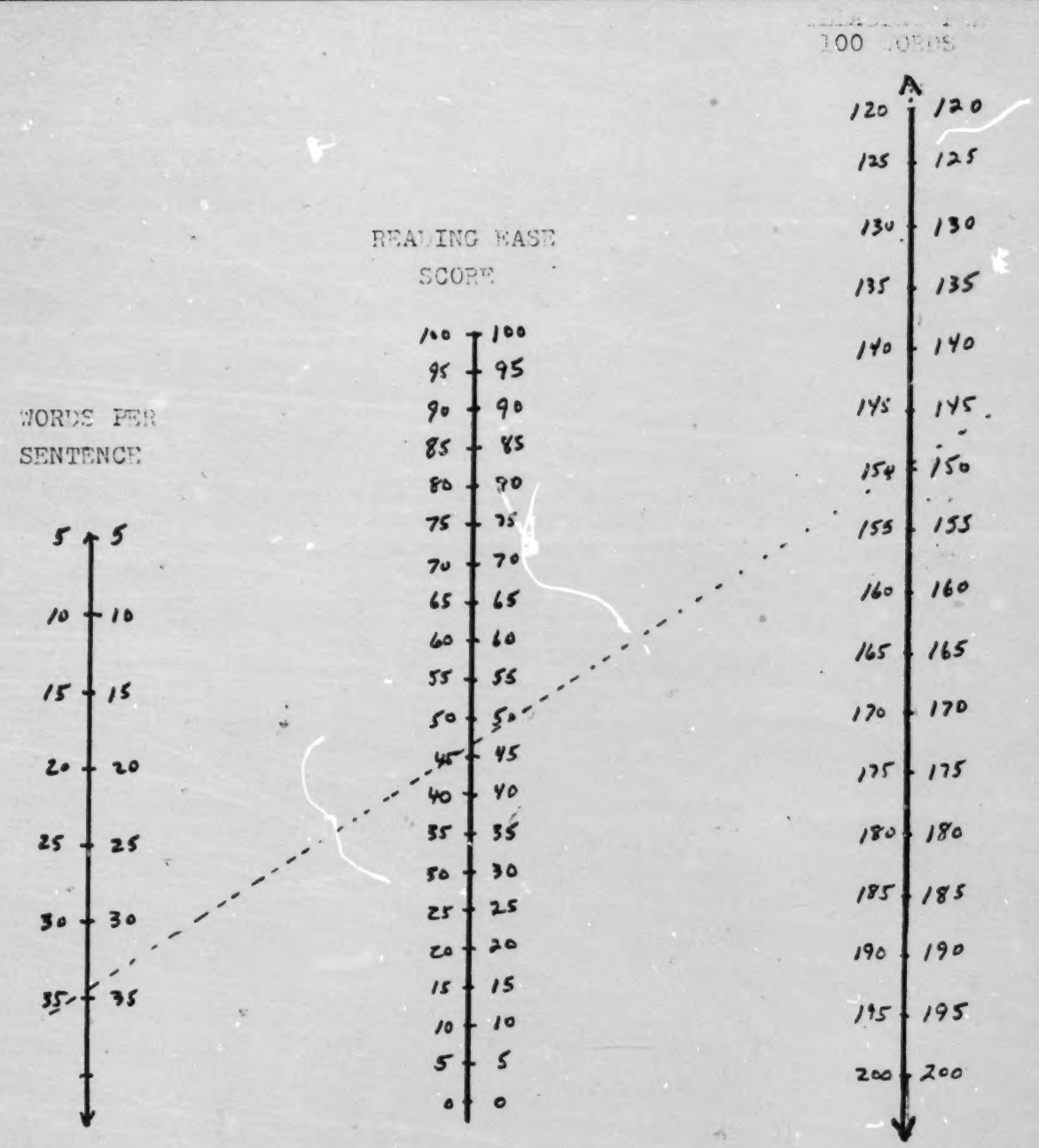

Figure 4: Flesh Reading Ease Chart: (Not drawn to scale; not valid for interpretation of literature)
Line is struck from scale of number of words per sentence to syllables per 100 words. Reading at center scale is "reading ease score."[44]

Reading Ease Score	Estimated Reading Grade
90 - 100	5th Grade
80 - 90	6th Grade
70 - 80	7th Grade
60 - 70	8th, 9th Grades
50 - 60	10th to 12th Grades
30 - 50	13th to 16th Grades
0 - 30	College Graduate[45]

This method contains another advantage for consideration in future studies. It was adapted for computer use by the University of Texas Instructional Materials Service.[46] Also, General Motors has provided a commercial computer program for the Flesh formula, the STAR (Simple Test Approach for Readability), using a syllable counter.[47]

As a procedural check on the validity of the Flesh method in this application, the Fry Graph for Estimating Readability is to be used.[48] This graph determines the approximate grade level of material by considering the average number of syllables per 100 words. It is being used for validation because of its high correlation with other formulas.[49] The results of the procedural check shall be discussed in the concluding section, but the scores used to establish the mean readability levels shall be obtained by the Flesh procedure. The Fry procedure utilizes a graph of the sentences per hundred and the syllables per hundred on respective axes to arrive at grade level. (See figure 5).

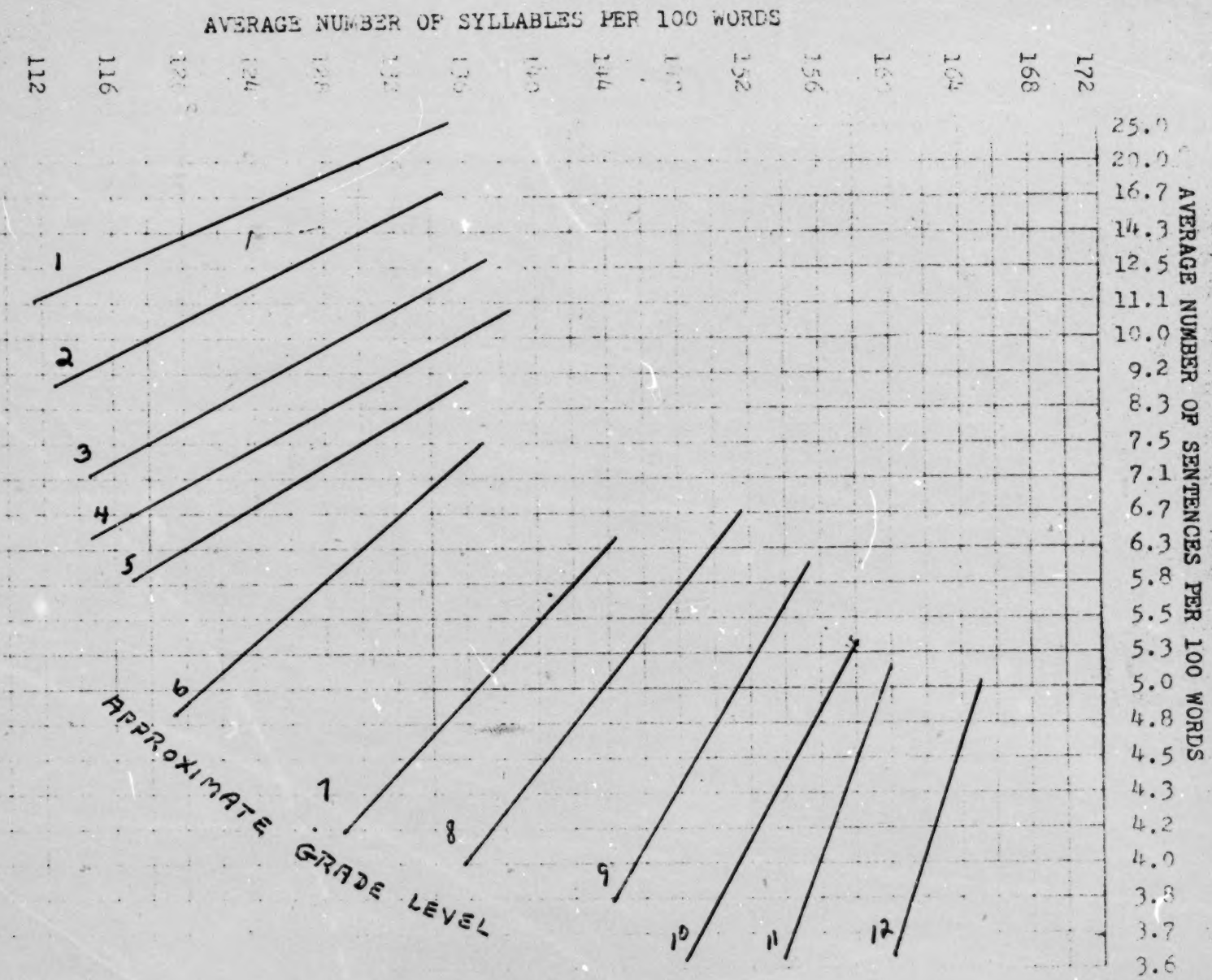

Figure 5: Fry Graph for Estimating Readability.[50]

Reading Ability

Determination of reading ability for carpentry students needed to be according to their ability with respect to actual materials they would be using in the practice of carpentry. Also, it was felt that simple verbal conversancy would not be indicative of their ability to read content materials. Thus, the test had to be one which utilized the materials installation instruction literature and the classroom instructional literature; and controlled for vocabulary loading of the test.

The cloze procedure is an objective measure of language correspondence between reader and writer.[51] Made up of a cloze (word) unit, a single occurrence of a successful attempt to reproduce accurately a part deleted from a message, by deciding from context that remains, what the missing part should be.[52]

The cloze procedure differs from vocabulary contextual tests in that, rather than choosing omitted words because of definition and purpose, the cloze units are chosen mechanically, occurring at any point in a continuous passage.

The cloze design incorporates control against misrepresenting strength/weakness in content vocabulary as indication of the test subject's ability/inability to read. This facilitates conclusion about the relationship between ability of the sample population and readability of the sample material.

There are three ways in which the test can be designed. The original design,[53] mutilation of the test message by deleting

certain words and substituting underlined blank spaces of constant length, utilizes no diagram assistance, as would be found in text and installation materials, to establish context. Also, it does not provide multiple choice of the missing word, relying on context for interpretation. Since this study is concerned only with reading ease and skill, there need be no diagram assistance. It is a valuable measurement of worth of material, but properly the subject of another study, concerned with evaluation of such assistance.

Because the text of the tests must be limited, recognizing the potential threat to validity of too long a test and unnecessary disruption of the students' normal program, a four word "multiple-choice" test shall be employed. This is done in lieu of the longer text which could contain contextual clues as to what word had been removed. No synonym shall be counted correct, only the exact word. (See Figure 6a, b, c.)

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[1]B.J. Levin "Reading Requirements For Satisfactory Careers." Reading and Career Education. Perspectives in Reading No. 19. Donald M. Nielsen and Howard F. Hjelm, Eds. (Delaware: International Reading Association, 1975), p. 78.

[2]A.D.W. Smith Generic Skills For Occupational Training. (Prince Albert, Saskatchewan: Training Research and Development Station, 1973.) In Thomas Sticht and Howard H. McCann "Reading Requirements For Career Entry." Reading and Career Education. (Delaware: International Reading Association, 1975), p. 64.

[3]Ibid., p. 65.

[4]Ibid., p. 66.

[5]George R. Klare "Assessing Readability." Reading Research Quarterly. X:1, 1974.

While many builders use copper or aluminum flashing, some use #90 mineral surfaced roll roofing. An 18 inch wide _____is cut the full length of the valley and is nailed _____place, mineral surface down, with as few nails as _____. This runs from eave to ridge. A second strip, _____ inches wide, mineral face up, is nailed up to _____. This provides 18 inches coverage for both sides of _____. Only drive nails in along outer edges, never closer _____than one inch, and use as few as possible. _____ inch to 18 inch width roll copper or aluminum _____is the more popular material for flashing. Always lay _____flashing in one piece. Always use copper nails with copper flashing, aluminum with aluminum.

Figure 6a: Page one of clozed test used in the study.

CIRCLE THE WORD THAT IS MISSING AT THE LEFT IN THE CHOICE OF FOUR WORDS BELOW. ONE WORD FOR EACH BLANK SPACE.

Strip	felt	portion	tab
to	in	on	for
necessary	possible	available	galvanized
plus	18	two	36
eaves	top	ridge	roof
valley	roof	shingle	ridge
on	in	together	apart
Up	Two	Seventeen	12
roofing	asphalt	metal	flashing
valley	each	roof	mineral

Figure 6b: Page two of clozed test used in this study.

INSTALLMENT OF UNDERLAYMENT

With Board or Decking Subfloors_____perpendicular to the joists, apply underlayment panels with edges_____the joists, and with ends offset at least two _____from a subfloor joint. Use a minimum particleboard thickness _____3/8-inch.

With Board or Decking Subfloors applied at an _____to the joists, apply the underlayment panels perpendicular to _____joists with end joints parallel to and over a _____. Use minimum particleboard thickness of 3/8-inch.

FASTENING - Nailing

_____ring grooved underlayment nails. Start nailing in center of _____and work toward edges. Drive nails perpendicular to surface _____set flush.

installed	used	applied	nailed
beneath	between	over	around
lengths	inches	feet	times
from	over	mitered	of
angle	opening	area	opposite
the	all	end	parallel
wall	beam	rafter	joist
Nail	Use	Drive	Supply
room	wall	panel	area
to	not	and	but

CUTTING GYPSUM BCARD

Gypsum board may be cut to size by sawing. Another method is to score with an awl or knife.

Small cutouts for electrical outlets and other openings are_____ with a keyhole saw or sabre saw. To _____the location of the electrical outlet cutouts, hold the _____ in place against the wall. With a wood block _____protect the board, tap around the outlet with a _____. An indentation of the outlet box will be made _____the back of the board to use as a _____for cutting.

When notching gypsum board for door or _____openings, make two saw cuts to the correct depth. _____final cut is made by scoring and snapping, the _____as when cutting the sheet to size. The cut edges of gypsum board may be smoothed with #2 sandpaper wrapped around a wooden block.

Figure 6c: Page three of clozed test used in this study.

32

56

made	scored	tried	practiced
find	mark	see	scribe
wall	hammer	cutout	panel
don't	to	mallet	cover
hammer	saw	hand	punch
through	over	on	from
guide	practice	panel	cutout
cellar	wall	dormer	window
all	the	panel	a
place	same	way	like

[6]Willis H. Wagner. Modern Carpentry. (So. Holland, Illinois: Goodheart-Wilcox Co., Inc., 1973), passim. A comprehensive single volume carpentry textbook, recommended for use by students in conjunction with laboratory work.

[7]Ibid., p. 30.

[8]Ibid., p. 69.

[9]Ibid., p. 195.

[10]Ibid., p. 344.

[11]Ibid., p. 376.

[12]Ibid., p. 405.

[13]Ibid., p. 452.

[14]Suggested Unit Course In: Framing, Sheathing and Insulation. Albany: Delmar Publishers, Inc., (1973), p. 234.

[15]Suggested Unit Course In: Interior and Exterior Trim. Albany: Delmar Publishers, Inc., (1975), p. 71.

[16]Ibid., p. 95.

[17]James G. Bennett and Martha C. Muncrief, eds. Instructional Materials For Occupational Education. (Ithaca: Cornell Institute For Research and Development In Occupational Education, 1975), passim.

[18]Martha Muncrief (Untitled research instrument) in Instructional Materials For Occupational Education. (Ithaca: Cornell Institute For Research and Development In Occupational Education, 1975).

[19]Bennett, op. cit. passim.

[20]See Readability section of "A Review of The Literature."

[21]Wagner, op. cit., passim.

[22]Suggested Unit Course In:Concrete Form Construction. Albany: Delmar Publishers, Inc., (n.d.), passim. Although there was no date of publication in the Delmar Series' Concrete Form Construction examined by Cornell, two of the facilities studied used that text. In one of them, a letter from the publisher was dated, 1946. The text, listed by the facility which used it as 1973 edition, contained no publication date, but the text was identical to the 1946 "edition." The only difference was the absence of a date after the

letter from the publisher and slightly different title page type.

[23]Framing, Sheathing, Insulation. supra. passim. In addition to this textbook, the 1946 "edition" was assessed in this study.

[24]Interior and Exterior Trim, supra, passim. In addition to this textbook, considered by Cornell, this study assessed the 1946 "edition" used by school districts within the sample. A comparison of the two is included.

[25]Klare, op. cit., p. 64.

[26]Edgar Dale and Jeanne S. Chall. "A Formula For Predicting Readability." Educational Research Bulletin 27 January 21 and February 17, 1948, pp. 11-20, 37-54.

[27]Klare, op. cit., p. 70.

[28]Walter R. Brown. "Science Textbook Selection and the Dale-Chall Formula." School Science and Mathematics. 65: February 1965, pp104-7. L.P. Stocker. "Increasing the Precision of the Dale-Chall Readability Formula." Reading Improvement 8: Winter, 1971-72, pp. 87-89.

[29]Klare, op. cit.,pp. 71,73.

[30]John B. Holmquist "A Determination of Whether The Dale-Chall Readability Formula May Be Revised To Evaluate More Validly The Readability of High School Science Materials." Unpublished Doctoral Dissertation. Colorado State University. 1968. See also Dissertation Abstracts, 29:407A, 1968. Also, in Klare, op. cit. pp. 71-2.

[31]Klare, op. cit., pp. 71-2.

[32]L.D. Crane "Levels of Structural Difficulty in Language and Readability." Dissertation Abstracts, 24:1746, 1963. In Klare, op. cit., p. 71.

[33]Klare, op. cit., p. 71.

[34]James N. Farr, James J. Jenkins, and Donald C. Paterson. "Simplification of Flesh Reading Ease Formula." Journal of Applied Psychology. 35: October, 1951, pp. 333-337.

[35]Klare, op. cit. p. 73.

[36]Robert Gunning. The Techniques of Clear Writing. (New York: McGraw-Hill, 1952; Revised edition, 1968.

[37]Klare, op. cit. p. 73.

[38]George Spache. "A New Readability Formula For Primary Grade Reading Materials." 53 Elementary School Journal, March, 1953. pp. 410-13.

[39]Milton D. Jacobson. "Reading Difficulty of Physics and Chemistry Textbooks in Use In Minnesota." Unpublished doctoral dissertation. University of Minnesota, 1961. See also Dissertation Abstracts, 1962, 22, 3950. Also in Klare, op. cit.

[40]Edmund B. Coleman "Developing A Technology of Written Instruction: Some Determiners of the Complexity of Prose. In E.Z. Rothkopf and P.E. Johnson (Eds.) Verbal Learning Research and the Technology of Written Instruction. New York: Teachers College Press, Columbia University, 1971. Also In Klare, op. cit.

[41]W. B. Elley "The Assessment of Readability By Noun Frequency Counts." 4 Reading Research Quarterly, Summer, 1969, pp. 411-27. Also in Klare, op. cit.

[42]Robert Arley Shaw "Criterion and Independent Variables and the Precision Indexes of These Variables as Used in Establishing a Formula For Predicting Reading Difficulty of Programmed Materials in Fourth Grade Science." Unpublished Doctoral Dissertation, University of Virginia, 1967. See also Dissertation Abstracts, 1968, 28, 3572A, 3573A. Also in Klare, op. cit.

[43]Rudolph Flesh The Art Of Readable Writing. (New York: Harper and Brothers, 1949), passim.

[44]Ibid., end papers.

[45]Ibid., p. 149.

[46]Klare, op. cit., p. 80

[47]Ibid., p. 88.

[48]Edgar B. Fry "A Readability Formula That Saves Time," 11 Journal of Reading, April, 1968. pp. 513-16, 675-78.

[49]Klare, op. cit., p. 73.

[50]Fry, op. cit., p. 577.

[51]Earl F. Rankin "The Cloze Procedure--Its Validity and Utility." Measurement and Evaluation of Reading, Roger Farr, Ed. New York: Harcourt, Brace, and World, Inc., 1970. pp. 237-53.

[52]W.L. Taylor "Cloze Procedure: A New Tool For Measuring Readability." 30 Journalism Quarterly, Fall, 1953. See also Farr, op. cit., p. 239.

[53]Ibid.

[54]Donald Brann Roofing Simplified. (Briarcliff Manor, N.Y.: Directions Simplified, Inc., 1974) p. 25.

[55]"How To Install Particleboard Floor Underlayment." National Particleboard Association, Silver Spring, Maryland.

[56]John L. Feirer and Gilbert R. Hutchings Carpentry and Building Construction. (Peoria, Illinois: Chas. A. Bennett Co., Inc.,1976), p. 746.

CHAPTER III

METHODS AND PROCEDURES

Materials and Projects Installation Instructions

Selection

All the literature files of one general carpentry contractor, representing approximately eight years of accumulation, were the sources of the carpentry literature used in the study.

These files were subdivided into two categories: materials installation instructions; and project instructions. Materials installation instructions were defined as those pieces of literature which described the carpentry procedures necessary for use or installation of a particular product or specific item. Project installation instructions were defined as those pieces of literature which were not related to a specific product or item, but described a carpentry project, including specific instructions of procedure for completion of that project.

These materials were further analyzed to exclude non-carpentry procedural instructions, such as, masonry, sheet metal work, plumbing and electrical procedure, about which the carpenter would have need for knowledge, but would not actually perform the installation. Also, the literature was compared with the control text:

Carpentry and Building Construction.[1] Any materials not covered by this text were excluded. (See Figures 1 and 2 for samples of the two categorical literatures and Appendixes 1 and 2 for the sources of all samples.)

Randomization

Approximate one-hundred word paragraphs or groups of paragraphs were randomly selected from the materials according to the following formula:

Single pages containing less than ten paragraphs--draw from shuffled cards numbered one to ten to determine the paragraph which was to serve as the beginning of the sample to be extracted;

Single pages of ten or more paragraphs--flip of coin: heads, begin at first paragraph and count forward to obtain sample; tails, begin at last paragraph and count back to sample; draw from shuffled cards, numbered one to ten, to determine beginning sample paragraph;

Literature containing more than one product or project was counted as separate single page brochure for each product or project; sampled as described above;

Literature containing two to five pages was sampled at the rate of one paragraph per page, randomly selected; 10 to 50 pages, one sample per five pages, with the first page selected by random draw; 51 to 250 pages, one per ten pages, with the first page selected by random draw; 251 to X, one

sample per fifteen pages, with the first page selected by random draw.

Each page was further subjected to randomization to determine a starting point. According to the flip of a coin, heads, representing plus, tails, representing minus, the word count was taken on plus samples from the first full paragraph forward, while on the minus samples, from the last full paragraph backward. Subsequent to the first page, each page thereafter alternated plus and minus.

Procedure

The sample was obtained by counting each word from the starting point achieved by the randomization schedule up to or back to the end or beginning of the last full sentence at which a total of 100 words was contained. Since few of the sentences ended exactly at 100 words, if the word count was at 95 or more at the end of the last full sentence, no further sentences were used. If the count was at 94 or less, another full sentence was included in the count. The samples, therefore, contained more or less than 100 words with each sample recorded on a 3x5 index card. (See Figure 7)

A sample number was assigned each sample recorded on the 3x5 card and the actual brochure. The beginning and ending words of the sample were recorded as well as the randomization schedule. As each count was taken, the number of words in the sample was recorded on the index cards. (See Figure 7)

A syllable count of each word was taken, using a Smith-Corona Figurematic 708 electric adding machine with a repeat key. This

(1) Number assigned sample
(2) Number words in sample
(3) Randomization schedule (plus or minus)
(4) Number of words per sent in sample
(5) Number of sentences in the sample
(6) Number of syllables in the sample
(7) Same as number 4; moved for efficiency
(8) Computed number of sentences per hundred words
(9) Computed number of syllables per hundred words
(10) Computed Flesh score.

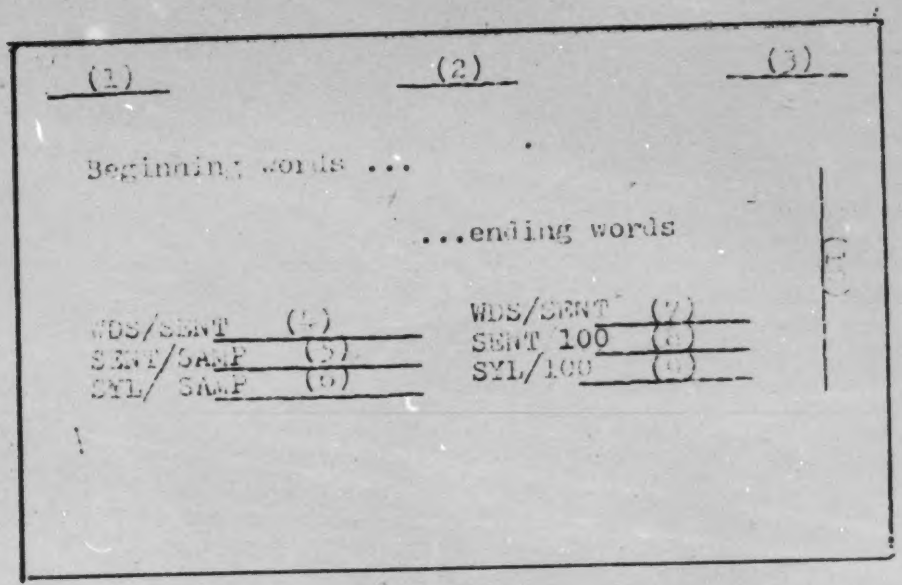

Figure 7: Sample recording procedure.

adding machine has a figure entry sound which occurs as each number is added into sub-total. The procedure was as follows:

(1) Number 1 key depressed;

(2) Repeat key depressed;

(3) Each syllable of each word was read to the sound of the figure entry occuring when the add/sub-total key was depressed;

(4) At the end of each sentence, the machine was cleared and a total recorded on the tape. Thus, for each sentence, the tape would show .01 for each syllable and the total of syllables for each sentence. (See Figure 8);

(5) Then the next sentence was read to the sound of figure entry for each syllable, and so forth, until the total sample had been read and the tape contained totals of syllable pertaining to each sentence of the sample;

(6) These totals were then entered and added to give the total syllables per sample and entered on the 3x5 card;

(7) The number of totals represented the number of sentences per sample; these were recorded on the 3x5 card. (See Figure 7).

To achieve the Flesh readability score, the number of words per sentence was calculated by dividing the total number of words per sentence by the total sentences per sample:

$$\text{WORDS/SENTENCE} = \frac{\text{WORDS PER SAMPLE}}{\text{SENTENCES PER SAMPLE}}$$

The syllables per sample had to be converted to syllables

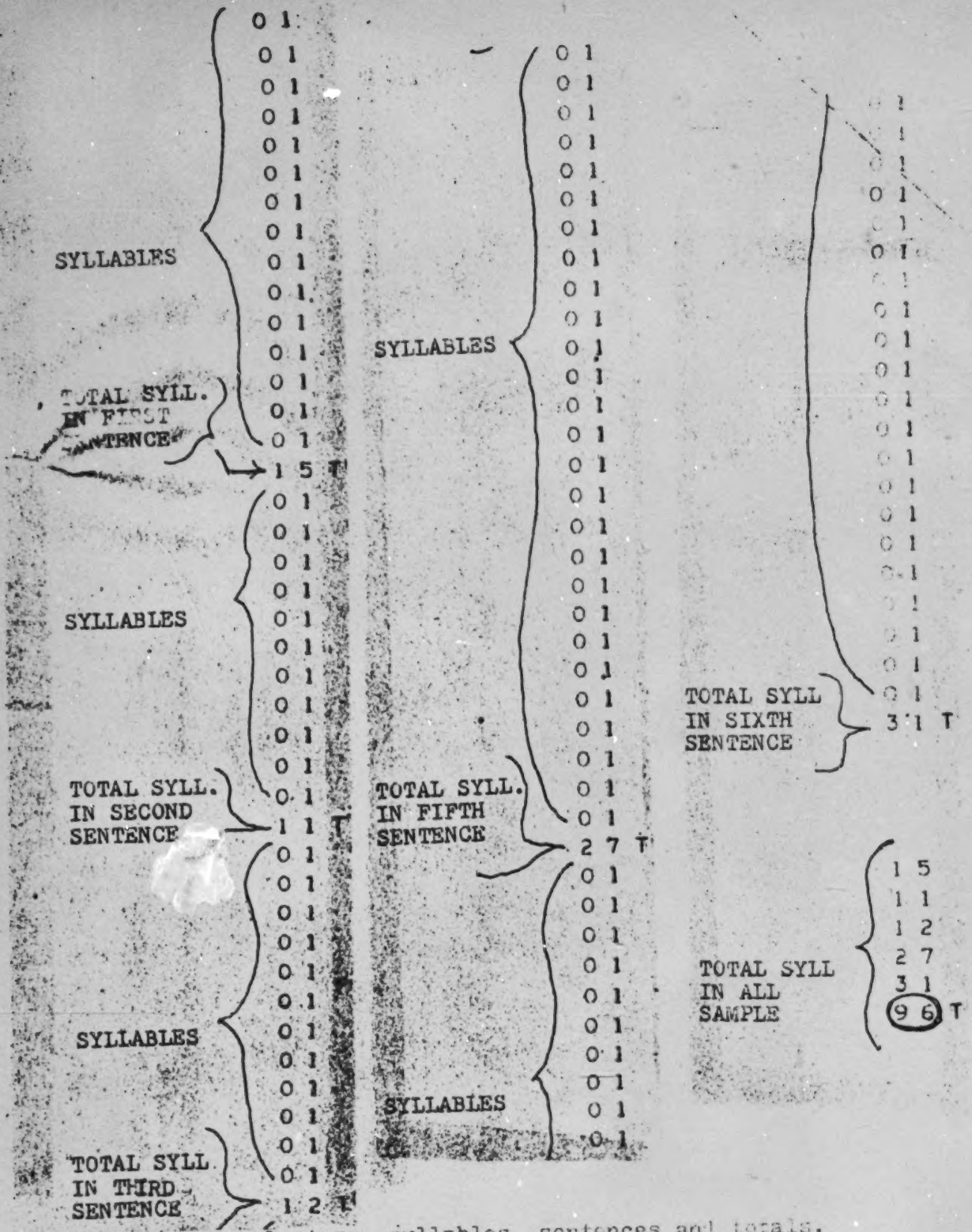

Figure 8: Sample tape, syllables, sentences and totals.

per 100 words:

$$\text{SYLLABLES/WORD} = \frac{\text{WORDS PER SAMPLE}}{\text{SENTENCES PER SAMPLE}}$$

$$\text{SYLLABLES/100 WORDS} = \frac{\text{WORDS PER SAMPLE}}{\text{SENTENCES PER SAMPLE}} \times 100$$

As the Fry Readability procedure requires number of sentences per 100 words, this computation was also made.

Each of these was entered on the 3x5 record card. (See Figure 7).

To obtain the Flesh Readability score, there are two optional procedures: (1) the Flesh Readability Graph as previously shown; (2) the following formula:[2]

READABILITY SCORE = 206.835 minus The Sum of
(1.015 X Words Per Sentence)
Plus
(.846 X Syllables Per 100 words.)

Each sample was scored according to this formula and the score entered on the 3x5 record card. (See Figure 7).

These scores were then graded according to the following conversion table:

Readability Score To Grade Level Conversion Table

95.0 - 100.0	Fifth (minus)
90.0 - 94.9	Fifth (plus)

85.9 - 89.9	Sixth (minus)
80.0 - 84.9	Sixth (plus)
75.0 - 79.9	Seventh (minus)
70.0 - 74.9	Seventh (plus)
65.0 - 69.9	Eighth
60.0 - 64.9	Ninth
55.0 - 59.9	Tenth, eleventh (minus)
50.0 - 54.9	Eleventh (plus), twelfth
30.0 - 49.9	Thirteenth to Sixteenth
0.0 - 29.9	College Graduate

This grading corresponds to the Flesh conversion table (See Page 26), previously described, expanded to account for high and low placement at grades five to seven readability levels, consistent with the high and low readings of the Flesh scores.

Sample

Two hundred seven approximate 100 word samples were taken: 105, materials installations instructions; 102 project instructions. Each was analyzed according to the preceeding procedure.

Textbooks

Selection

To determine the mean readability of carpentry textbooks, all the textbooks of the sample population of students were subjected to the Flesh analysis for readability. (See Appendix IV).

In addition, one comprehensive carpentry textbook was selected and analyzed for control purposes. That text was the Feirer and Hutchings, Carpentry and Building Construction.[3]

Randomization

In order to determine the number of samples which would need to be taken from the textbooks, the Feirer and Hutchings text was first analyzed on the basis of a stratified random selection from one page per ten pages. It was again analyzed on the basis of a selection from one page per fifteen pages. The resultant Flesh score of each analysis differed by 0.15, insignificant in conversion to grade level. Therefore, the following random extraction schedule was adopted:

10 to 50 pages: one per five pages
51 to 250 pages: one per ten pages
251 to XX pages: one per fifteen pages.

Cards numbering 1 to 10 were shuffled. One card was drawn to determine the starting page for sample extraction. Each page was then further subjected to randomization to determine a starting point. According to the toss of a coin--heads representing plus; tails representing minus--the word count was taken on plus samples from the first full paragraph forward, and on the minus samples from the last full paragraph backward. Subsequent to the first page sampled, each page thereafter was alternated plus or minus.

If the page selected according to random draw contained no text the next page backward or forward, according to plus and minus schedules respectively, were used. Samples were not taken from tables of contents, lists of illustrations, illustration captions, glossaries, appendixes, or indexes. Parenthetical expressions were counted as separate sentences if: (1) the first part of the

sentence in which it was contained made sense before the parentheses; (2) added additional information, rather than another way of expressing the same thought; (3) referred to a diagram.

Paragraph numbers were not counted as independent sentences. Step numbers were considered as independent sentences, because the implication of a step number is "Do this first...Then do this... Then do this..." There is language contained in the number, implicit in the understanding of procedure. Paragraph numbers are merely words which are placed for the organization of the written material, of benefit to the writer, requiring additional reading by the reader, without a language content. Counting them as sentences would greatly reduce the words per sentence and increase the sentences sentences per hundred, diluting the readability score.

Procedure

Following the randomization schedule, the procedure for analysis was the same as that for materials/projects installation instructions, previously described, to the end of achieving a Flesh score and conversion to grade level.

Reading Ability

Selection

Criteria for selection of the sample population to be tested at the means established in the readability analysis included:

(1) the largest possible sample which could be tested in the time frame of the study; (2) 11th and 12th grade carpentry students (as defined) who were involved in laboratory courses and outside projects.

It was the opinion of the researcher that approximately 100 students could be tested within the two to three weeks allowed for testing. Thus, facilities were sought which, when combined, would provide a total sample of approximately 100 students.

Three facilities with a combined enrollment of 112 11th and 12th grade carpentry students in laboratory classes involving outside projects were selected. These were made up of two area schools representing enrollments from 26 high schools in 26 different school districts; and one comprehensive high school, representing three high schools within one school district.

In order to preserve the confidentiality of the students' performance, the specific facilities participating shall not be identified. Enrollments in these facilities represent urban, suburban, and rural areas, and include the racial and ethnic distribution consistent with that of "Central New York." Racial, ehtnic, and socio-economic data for the sample population is not subject for consideration of this study.

Two factors affected the dates of testing: (1) the weather; (2) test preparation date, which was dependent upon the data analysis of readability portion of the study. In preliminary discussions with the facilities, it was decided to establish a target period for testing, pending the outcome of the readability anal-

ysis. Then, within that period, testing would be accomplished on any rain day (weather precluding outside work) up to a cut-off point. If no rain days occurred, the tests would be given on the cut-off date.

The students were normally divided into a morning and afternoon session, with different students in each session. Therefore, two testing times, 8:30 AM and 12:30 PM, were set for each facility.

During the fourth week of October, 1977 and the first week of November, 1977, ninety-two 11th and 12th grade carpentry students were tested at the three facilities:

October 27, 1977	Facility 1	33 students, By Appointmen
October 28, 1977	Facility 2	38 students, Cut-off date
November 4, 1977	Facility 3	21 students, Rain Date

Procedure

Instructions

The instructors were asked not to discuss the fact that a test would be given their students, or any information about the testing. Facility number 2 students evidenced some advance knowledge, but believed the procedure to be a questionnaire.

All the instructions regarding the test were given by the researcher at the time of the testing.

The Test

Based upon the mean readability scores for each category described: materials installation instructions, project instructions, and textbooks, a sample of that literature was selected

corresponding to the mean readability. The selection for materials installation instructions and project instructions was made from the samples analyzed. The textbook selection was made from Feirer and Hutchings, Carpentry and Building Construction,[4] to establish control for the possible threat to internal validity by the subjects having had advance exposure to the testing instrument.

Each of the three passages were clozed according to a stratified randomization. The first word for clozing was determined by random draw from cards numbered 1 to 10. Each tenth word thereafter was deleted, until a total of ten deletions was accomplished.

The correct word for each deletion was then randomly assigned a position: one, two, three, or four; placed accordingly in the multiple-choice selection grouping. Three incorrect choices were developed according to: (1) a word with similar meaning; (2) a word with opposite meaning; (3) a word with greater or lesser quantity; (4) a different grammatical expression; (5) a word which, although a part of carpentry instruction, was a different part from the task, i.e., valley-ridge, shingle-roof, beam-rafter. These choices were listed to the right of the clozed passage, directly opposite the deleted word. (See Figures 6a, 6b, 6c.)

The test was contained in an 8½ by 11 inch booklet with a blank cover page. The students were asked to record their grade in school and year in laboratory carpentry class of the cover. They were instructed not to record their names and that the test results would not be identified regarding how each did, individual-

ly. Further, the students were advised that the results would not affect their grade or standing in the class.

Subsequent to the testing, the classroom teacher submitted a list of the students who participated in the testing to their respective principals. From this list, the diagnostic reading test scores, contained in the students' files, along with the type of test and date taken, was to be reported to the researcher. The report was not to include the names of the students who participated. Facility Number 1 was the only school to comply. The other two had no such information on file and were unwilling to solicit this material from the home schools.

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[1]John L. Feirer and Gilbert R. Hutchings Carpentry and Building Construction (Peoria, Illinois: Chas. A. Bennett Co., Inc. 1976), passim.

[2]Rudolf Flesh The Art Of Readable Writing (New York: Harper & Brothers, 1949), p. 216.

[3]Feirer, Op. Cit.

[4]Ibid.

CHAPTER IV

FINDINGS OF THE STUDY

Readability Analysis

Under the heading of readability, two major groups of data emerge; those dealing with analysis of carpentry installation instructions and those pertaining to analysis of carpentry classroom literature. In order to present the data with consistency and, hopefully, clarity, each group shall be presented separately, with all the respective subsections, concluding with a summary after both items have been expressed.

Carpentry Literature

The following constitutes the data with respect to all carpentry literature used in the study to establish a mean readability of said literature:

Total number of samples.....207
Total number of words.....21,799
Total number of sentences.....1,642
Total number of syllables.....33,905
Total sentences/100 words.....7.53
Total syllables/100 words.....155.53

Total number words/ sentences..13.28

Flesh Score: 61.78 Fry Coordinates: 7.53/155.53

Flesh Readability Level.....9th Grade (High)

Fry Readability Level.....9th Grade (Low)

Figure 9: Carpentry Installation Instruction Readability Frequency Distribution (207 Samples)

Flesh Score	Grade	Number	Percent
95.0 - 100.0	5 minus	01	0.5%
90.0 - 94.9	5 plus	01	0.5
85.0 - 89.9	6 minus	02	1.0
80.0 - 84.9	6 plus	08	3.9
75.0 - 79.9	7 minus	16	7.7
70.0 - 74.9	7 plus	28	13.5
65.0 - 69.9	8	32	15.5
60.0 - 64.9	9	29	14.0
55.0 - 59.9	10 to 11	22	10.5
50.0 - 54.9	11 to 12	23	11.1
30.0 - 49.9	13 to 16	43	20.8
0.0 - 29.9	Graduate	02	1.0%

In this study, the carpentry literature was divided into two categories: (1) that which would accompany materials for installation instructions purposes; (2) project literature which would describe procedures for task accomplishment.

Materials Installation Instructions

The following data is the analysis yield of that literature

described as materials installation instructions (See Appendix I):

Total number of samples.....105

Total number of words.....11,384

Total number of sentences.....889

Total number of syllables.....17,884

Total sentences/100 words.....7.81

Total syllables/100 words.....157.1

Total words/sentences.....12.81

Flesh Score: 60.93 Fry Coordinates: 7.81/157.1

Flesh Readability Level.....9th Grade (high)

Fry Readability Level.....9th Grade (high)

Figure 10: Materials Installation Instructions
Readability Frequency Distribution

Flesh Score	Grade	Number	Percent
95.0 - 100.0	5 minus	01	01.0%
90.0 - 94.9	5 plus	00	00.0
85.0 - 89.9	6 minus	02	01.9
80.0 - 84.9	6 plus	05	04.8
75.0 - 79.9	7 minus	09	08.6
70.0 - 74.9	7 plus	11	10.5
65.0 - 69.9	8	16	15.2
60.0 - 64.9	9	16	15.2
55.0 - 59.9	10 to 11	09	08.5
50.0 - 54.9	11 to 12	12	11.4
30.0 - 49.9	13 to 16	23	21.9
0.0 - 29.9	Graduate	01	01.0

Projects Instructions

The following data is the analysis yield of that literature described as project installation instructions (See Appendix II):

Total Number of Samples.....102

Total Number of words.....10,415

Total Number of Sentences.....753

Total Number of Syllables.....16,021

Total Sentences/100 words.....7.23

Total Syllables/100 words.....153.83

Total words/sentences.....13.83

Flesh Score: 62.66 Fry Coordinates: 7.23/153.8

Flesh Readability Level.....9th (middle)

Fry Readability Level.....9th (Low-middle)

Figure 11: Project Instructions
Readability Frequency Distribution

Flesh Score	Grade	Number	Percent
95.0 - 100.0	5 minus	0	00.0%
90.0 - 94.9	5 plus	01	01.0
85.0 - 89.9	6 minus	01	01.0
80.0 - 84.9	6 plus	03	02.9
75.0 - 79.9	7 minus	07	06.9
70.0 - 74.9	7 plus	17	16.7
65.0 - 69.9	8	16	15.7
60.0 - 64.9	9	13	12.7
55.0 - 59.9	10 to 11	13	12.7
50.0 - 54.9	11 to 12	11	10.8
30.0 - 49.9	13 to 16	20	19.6
0.0 - 29.9	Graduate	0	00.0%

Classroom Instructional Literature

Three categories of classroom instructional literature were examined in this study: (1) all textbooks used by the facilities represented in the study (See Appendix IV); (2) the control textbook; (3) a selection of attendant materials not contained in the preceeding two groups. The third category included: (1) the review questions contained in the first category textbooks; (2) Comprehensive Examination In Carpentry, June 1977, Parts I and II, N.Y. State Education Department (See Appendix V); (3) Texas Education Agency, Construction Industry Series, Wood - Student Manual and Finishing - Student Manual.[1] (See Appendix IV). The Texas Education Agency materials were selected because they represent materials to be used in a modular type concept of educational organization, presently the direction of education in many states, including New York.

Sample Population Textbooks

Figure 12 contains the analysis yield of the textbooks used by the sample facilities. Using the Flesh and Fry Analyses for the total number of words, sentences, and syllables for all the textbooks in the sample:

Flesh Readability: 70.20 - 7th grade plus (high);

Fry Readaiblity: 6.53/143.15 - 7th grade plus (middle).

The average of all the textbooks sampled, however, results in:

Total Sentences/100 words.....6.79

Figure 12: Sample Population Textbooks Data

Textbooks	No. Samp	No. Words	Sent/ Samp.	Syl/ Samp.	Sent/ 100	Syl/ 100	Word/ Sent	Flesh Score	Fry Coor.	Flesh Grade	Fry Grade
Delmar, Concrete Form Construct.[2]	11	1124	89	1508	7.92	134.16	12.63	80.52	7.92/ 134.16	6 plus high	6 min. high
Delmar, Interior Exterior Trim[3]	18	1865	126	2457	6.76	131.74	14.80	80.36	6.76/ 131.74	6 plus high	6 plus mid.
Delmar, Stair Layout[4]	5	541	39	741	7.21	136.97	13.87	76.88	7.21/ 136.97	7 min. mid.	7 min. low
Delmar, Framing, Sheath., Insulat.[5]	24	2490	153	3484	6.15	139.92	16.27	71.95	6.15/ 139.92	7 plus mid.	7 plus mid.
Fundamentals of Carp. Volume I.[6]	23	2396	167	3641	6.97	151.96	14.35	63.71	6.97/ 151.96	9th low	8 plus high
Fundamentals of Carp. Volume 2.[7]	33	3453	199	4978	5.76	144.16	17.35	67.27	5.76/ 144.16	8th mid.	8th low
Delmar, Concrete Form Construct.[8]	11	1124	89	1508	7.92	134.16	12.63	80.52	7.92/ 134.16	6 plus high	6 min. high
Modern Carpentry[9]	31	3258	212	5143	6.51	157.86	15.37	57.68	6.51/ 157.86	10/11 mid.	10th mid.
Delmar, Hand Wood-working Tools[10]	19	1998	138	2809	6.91	140.59	14.48	73.20	6.91/ 140.59	7 plus mid.	7 plus low
Delmar, Framing, Sheath., Insulat.[11]	24	2548	147	3502	5.77	137.44	17.33	72.97	5.77/ 137.44	7 plus mid.	7 plus low
Totals	199	20797	1359	29771	6.53	143.15	15.30	70.20	6.53/ 143.15	7plus high	7 plus mid.

Total Syllables/100 Words.....140.9

Total Words/Sentence.....14.91

This computes to Flesh Score, 72.5, with Fry coordinates, 6.79/140.9;

Average Readability All Texts

Flesh Readability Grade.....7 plus (middle)

Fry Readability Grade.....7 plus (low).

Each of the three facilities used a different combination of textbooks. Thus, the readability level of the materials, by facility, differs from the average readability level of all materials. See Figure 13.

In addition to the data yields in Figure 13, Figure 14 depicts the distribution of samples according to grade level, by facility.

Figure 13: Textbook Readability Levels By Facility

Facility I Textbook	Flesh Score	Fry Co-ordinates	Flesh Grade	Fry Grade
Concrete Form Construction [12]	80.52	7.92/	6 plus high	6 min. high
Delmar, Hand Wood-working Tools [13]	73.20	6.91/ 140.59	7 plus mid.	7 plus low
Delmar, Framing, Sheath., Insulation [14]	72.97	5.77/ 137.44	7 plus mid.	7 plus low
Averages	75.56	6.87/ 137.40	7 minus mid.	7 minus mid.
Facility II				
Modern Carpentry [15]	57.68	6.51/ 151.86	10 to 11 mid.	10th mid.

Facility III

Textbook	Flesh Score	Fry Co-ordinates	Flesh Grade	Fry Grade
Delmar, Concrete Form Construction[16]	80.52	7.92/ 134.16	6 plus high	6 minus low
Delmar, Interior Exterior Trim[17]	80.36	6.76/ 131.74	6 plus high	6 plus mid.
Delmar, Stair Layout[18]	76.88	7.21/ 136.97	7 minus mid.	7 minus low
Delmar, Framing, Sheath., Insulation[19]	71.95	6.15/ 139.92	7 plus mid.	7 plus mid.
Fundamentals of Carpentry, Vol. I[20]	63.71	6.97/ 151.96	9th low	8 plus low
Fundamentals of Carpentry, Vol II[21]	67.27	5.76/ 144.16	8th mid.	8th low
Averages	73.45	6.80/ 139.81	7 plus high	7th mid.

Figure 14: Readability Score Frequency Distribution By Facility and Textbook

Facility I

Grade Level	Concr. Constr.[22]	Hand, Wd. Wrk. Tls[23]	Framing Sh., Ins[24]	Totals	Percent
5 minus	2	0	0	2	3.7%
5 plus	2	0	0	2	3.7
6 minus	1	1	0	2	3.7
6 plus	1	4	5	10	18.5
7 minus	3	1	9	13	24.1
7 plus	0	5	3	8	15.0
8 th	0	5	2	7	12.9
9 th	0	2	1	3	5.5
10 to 11	2	0	2	4	7.4
11 to 12	0	1	3	3	5.5
13 to 15	0	0	0	0	0.0
Graduate	0	0	0	0	0.0

Facility II

Grade Level	Modern Carpent.[25]	Totals	Percent
5 minus	0	0	0
5 plus	0	0	0
6 minus	2	2	06.5%
6 plus	1	1	03.2
7 minus	1	1	03.2
8th	2	2	06.5
9th	7	7	22.5
10 to 11	4	4	12.9
11 to 12	2	2	06.5
13 to 16	8	8	25.8
Graduate	1	1	03.2

Facility III

Grade Level	Int. Ext.[26]	Fund. V. I.[27]	Fund. V.II.[28]	Stair Lay.[29]	Fr. Sh. Ins.[30]	Conc. Form[31]	Tot.	Per cent
5 min.	0	1	0	0	0	2	3	02.6%
5 pl.	2	0	0	1	0	2	5	04.3
6 min.	4	2	1	0	0	1	8	07.0
6 pl.	5	0	5	1	5	1	17	14.8
7 min.	1	3	3	0	7	3	17	14.8
7 pl.	3	4	2	1	2	0	12	10.4
8 th	1	2	8	1	5	0	17	14.8
9 th	2	3	6	1	0	0	12	10.4
10/11	0	1	2	0	1	2	6	05.2
11/12	0	3	3	0	2	0	8	07.0
13/16	0	5	3	0	2	0	10	08.7
Grad.	0	0	0	0	0	0	0	00.0

Control Textbook

To arrive at a textbook testing instrument with which the

subjects would have had no familiarity, it was necessary to select a comprehensive text other than those used by the sample population. This text, Carpentry and Building Construction[32] yielded the following readability data:

Total number of samples.....106
Total number of words.....10,608
Total number of sentences.....759
Total number of syllables.....16,267
Total sentences/100 words.....7.15
Total syllables/100 words.....153.35
Total words per sentences.....13.98

Flesh Score: 62.91 . Fry Coordinates: 7.15/153.35

Flesh Readability Level.....9th (middle)
Fry Readability Level.....9th (low)

The sample used for testing purposes was based upon the mean established by the sample population textbooks analysis, thus, the relative high readability level (high meaning requiring high reading ability skills level) does not affect the instrument. Although the textbook is not used by the sample population in this study, its frequency distribution of readability grades is demonstrative of yet another textbook designed for students in situations parallel to those of this study whose readability level is widely distributed. (See Figure 15).

Texas Education Agency: Construction Industry Series. As

Figure 15: Readability Score Frequency Distribution
Control Textbook

Grade Level	Number	Percent
5 minus	01	00.9%
5 plus	03	02.8
6 minus	04	03.8
6 plus	04	03.8
7 minus	10	09.4
7 plus	08	07.6
8 th	17	16.0
9 th	22	20.8
10 to 11	13	12.3
11 to 12	07	06.6
13 to 16	16	15.1
Graduate	01	00.9%

- -

stated previously, one sample of a text for modular concept use was included for comparison. This sample amounted to two student manuals within the series. Their data follows:

Finishing[33]

Total Number of Samples.....12
Total Number of Words.....1302
Total Number of Sentences.....82
Total Number of Syllables.....1957
Total Sentences/100 words.....6.30
Total Syllables/100 words.....150.31
Total Words/Sentences.....15.88

Flesh Score: 63.56 Fry Coordinates: 6.30/150.3

Flesh Readability Level.....9th (low)
Fry Readability Level.....9th (low)

Wood:[34]

Total Number of Samples.....7
Total Number of Words.....876
Total Number of Sentences.....55
Total Number of Syllables.....1385
Total Sentences/100 words.....6.28
Total Syllables/100 words.....158.11
Total Words/Sentences.....15.93

Flesh Score: 56.90 Fry Coordinates: 6.28/158.1

Flesh Readability Level.....10th to 11(minus)
Fry Readability Level.....10th (middle).

Textbook Review Questions. None of the Delmar Series, early or late editions, contained review questions. Volume 1 of Fundamentals of Carpentry[35] review questions scored one grade lower than the readability score for the text:

Score	Review	Text
Flesh	69.26	63.71
Fry	9.24/ 151.53	6.97/ 151.96
Flesh	8th(high)	9th(high)
Fry	8th(low)	9th(low)

Fundamentals of Carpentry, Volume 2[36] review questions scored one grade higher than the readability grade level of the text:

Score	Review	Text
Flesh	62.34	67.27
Fry	8.83/ 160.20	5.76/ 144.16
Flesh	9th (mid)	8th (mid)
Fry	9th (high)	8th (mid)

Wagner's, Modern Carpentry,[37] review questions scored considerably lower than the text:

Score	Review	Text
Flesh	70.67	57.69
Fry	6.21/ 141.65	6.51/ 157.86
Flesh	7 plus	10 to 11
Fry	7 plus	10th (mid)

Comprehensive Examination In Carpentry.[38] The New York State Comprehensive Examination In Carpentry is a standardized statewide examination, established for the purpose of examining high school students completing the carpentry program at their respective high schools.

It is a two-part examination which may be given on the same day or on two separate occasions. It is prepared by the University of the State of New York, in conjunction with the State Education Department. The questions are prepared annually by a panel consisting of educators and experts in the fields of carpentry and carpentry education.

The readability levels of the two parts are offered herein for supplementary information purposes, as no part of this exam-

ination was used or examined beyond readability in this study. (See Appendix V). The data yields were as follows:

Part One:
Flesh Score: 67.29 Grade: 8th (mid)
Fry Coord: 6.33/
145.99 Grade: 8th (low)

Part Two:
Flesh Score: 64.20 Grade: 9th (low)
Fry Coord: 5.41/
146.40 Grade: 8th (high)

Reading Ability

Having established the mean readability levels for the carpentry installation instruction subsections and the textbooks, the next procedure was to test the sample population at these levels, using real, as opposed to simulated, materials prepared for testing by the cloze procedure, as described previously.

The data yield shall consist of: (1) scores for the total test, all facilities; (2) scores for the total test, each facility; (3) scores for each level of readability, all facilities; (4) scores at each level, each facility; (5) mean scores at each level, each facility, according to the grade of the student.

The following is the yield of the analysis of the total test:

Total Number of Words.....303
Total Number of Sentences.....21
Total Number of Syllables.....447
Total Sentences/ 100 words.....6.93

Total Syllables/ 100 Words.....147.52

Total Words/ Sentences.....14.43

Flesh Score: 67.39 Fry Coordinates: 693/147.52

Flesh Readability Level.....8th (mid)

Fry Readability Level.....8th (low)

At an 8th grade readability level, the students tested scored as follows:

	Scale	Facility I	II	III	Total
Frustrational	0 - 09.9				
	10 - 19.9				
	20 - 29.9				
	30 - 39.9				
	40 - 49.9	2	2	2	6
Instructional	50 - 59.9	4	8	4	16
	60 - 69.9	7	14	7	28
	70 - 79.9	7	10	6	23
	80 - 89.9	1	2	2	5
Independent	90 - 99.9				
	100.0				
		21	36	21	78

Note: Facility one had seven veterans, four special education students and Facility two had two veterans: all were omitted by definition. This reduced the total population to seventy-eight instead of the original ninety-two.

Scores: Facility One.

Thirty-three students were tested. Of the thirty-three, seven were veterans; four were special education; and one was a tenth grader in the program. These twelve students were omitted from the

following data analysis and displayed separately:

	Test Page 1 9th Grade(low)	Test Page 2 9th Grade(high)	Test Page 3 7th Grade (mid)
1	0	0	0
2	1	0	0
3	4	2	0
4	2	2	0
5	7	3	0
6	3	2	3
7	3	8	4
8	1	3	5
9	0	1	6
10	0	0	3
	Mean: 4.95	Mean: 6.90	Mean: 8.1
		Veterans	
1	0	0	0
2	0	0	0
3	0	0	0
4	2	1	0
5	1	2	0
6	2	2	0
7	0	2	1
8	2	0	1
9	0	0	3
10	0	0	2
		Special Education	
	3 to 5 range	0 to 4 range	3 to 9 range

Scores: Facility Two:

Thirty-eight students were tested in facility two, of which two were veterans. These scores were omitted from the following data presentation:

	Test Page 1 9th Grade (los)	Test page 2 9th Grade (high)	Test Page 3 7th Grade (mid)
1	0	0	0
2	0	0	0
3	5	1	0
4	2	2	2
5	12	8	1
6	7	15	2
7	4	6	10
8	4	3	10
9	2	1	9
10	0	0	2
	Mean:5.52	Mean: 6.00	Mean: 7.92

Two veterans scored each:

1.	6	8	8
2	7	5	8

Scores: Facility Three:

The third facility consisted of twenty-one students, none of whom were veterans, special education, or outside the defined limits. Their data was as follows:

	Test Page 1 9th Grade (low)	Test Page 2 9th Grade (high)	Test Page 3 7th Grade (mid.)
1	0	0	0
2	0	0	0
3	0	3	1
4	8	1	0
5	4	4	0
6	3	4	2
7	4	5	6
8	2	3	4
9	0	1	6
10	0	0	2
	Mean: 5.43	Mean: 5.95	Mean: 7.76

In the process of establishing the validity of the test, a

question arose regarding whether there would be a distinction in score distribution between the 11th grade (1st year carpentry student) and the 12th Grade (second year carpentry) student. If the psycho-motor skills being taught in the courses was a major factor in the determination of the outcomes, thus, diluting the relevancy of the reading test, the second year carpentry students should have a higher mean total score than the first year students.

Figure 16: 11th-12 Grade Mean Scores On Three Test Levels By Facility

	Facility I		Facility II		Facility III	
	11th	12th	11th	12th	11th	12th
Test Page 1	5.20	5.10	5.12	6.10	5.65	4.50
Test Page 2	6.30	6.27	6.18	5.84	6.18	5.00
Test Page 3	8.10	8.09	7.41	7.89	8.00	6.75

Data Analysis Summary

Regarding the readability of all carpentry installation instructions, the Flesh analysis indicated an overall grade level of 9th grade, confirmed by the Fry Graph. The frequency distribution of 207 samples demonstrated two modes; one at the 8th grade level; and another at the 13 to 16 grade readability level. The materials were then divided into two sub-groups: materials installation instruction and the project instructions. Materials installation yielded a 9th grade level of readability and was

confirmed by the Fry Graph. The frequency distribution, in Figure 10, demonstrated bimodality at the 8-9th grade level and at the 13 to 16th level. Project installation instructions were found to be at the mid-9th grade level, confirmed by Fry Graph at the low-mid 9th grade. The frequency distribution in Figure 11 indicated bimodality at the 7th plus level and at the 13 to 16th level.

Combined sample population textbooks readability level was found to be 7th grade plus, confirmed by Fry Graph. Averaging individually computed readability scores confirmed the level, but demonstrated a distinction between the Flesh and Fry method of approximately one-half grade.

Figure 12 indicates a range of readability scores for the sample population textbooks from first half sixth grade to mid-range 10th to 11th grade. The Delmar texts scored the lowest grade levels of readability, 6th minus to 7th plus; Fundamentals of Carpentry next at 8th low to 9th low, confirmed at half-year variances; Wagner's text highest at 10th to 10th and 11th grade levels.

The readability range of textbooks grouped by facility was low 7th to mid-range 10th to 11th. According to Figure 13, Facilities I and III averaged in the low to high 7th grade, while Facility II averaged in the 10th to 11th grade levels. In Facilities I and III, the modes were consistent with the means, but in Facility II, the distribution of levels of their single text was bimodal at the 9th and 13th to 16th levels.

The control textbook yielded a confirmed readability level of 9th grade, with readability score distribution bimodal at the 9th and 13th to 16th levels. The two modular concept student manuals were found to be at the 9th grade and 10th to 11th grade levels respectively.

None of the Delmar texts contained review questions. The Fundamentals of Carpentry volumes review questions scored one grade lower than the text in volume one and one grade higher than the text in volume two. Wagner's, Modern Carpentry, scored a confirmed three grades lower for the review questions than the 10th grade text level.

The New York State Carpentry Examination scored a confirmed eighth level for part one and high eighth to low ninth for the second part.

The test developed to examine reading ability of the test subjects was found to be at the 8th grade level of readability. None of the students tested scored in the frustrational level of the total test; most were within the instructional level.

Facility One students scored mean scores of 4.95, 6.90 and 8.1 on the test pages one to three respectively. Facility Two students scored 5.52, 6.00 and 7.92, respectively. Facility Three students scored 5.43, 5.95, and 7.76, respectively.

In a comparison of the 11th grade and 12th grade students' mean scores at each test level, there was a variance of one-tenth or less, with the 11th grade scores higher, for those students at Facility One. In Facility Two, the scores were mixed, with the

page one test scores containing the greatest variance of .98 higher for the 12th grade means; page two, higher for the 11th at .34; and page three higher for the 12th at .48. Facility Three 11th grade students scored consistently higher on each of the three tests pages, varying 1.15, 1.18 and 1.25, respectively.

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[1] Wood - Student Manual and Finishing - Student Manual Construction Industry Series (Austin, Texas: Texas Education Agency, 1975) pp.3, 12, 22, 32, 42, 52, 60, and pp. 7, 22, 32, 44, 47, 62, 72, 82, 92, 102, 112, respectively.

[2] Suggested Unit Course In: Concrete Form Construction (Albany: Delmar Publishers, Inc., (1946)), passim.

[3] Suggested Unit Course In: Interior Exterior Trim (Albany: Delmar Publishers, Inc., (1946)), passim.

[4] J. Douglas Wilson and S.O. Werner Simplified Stair Layout (Albany: Delmar Publishers, Inc., (1947)), passim.

[5] Suggested Unit Course In: Framing, Sheathing, and Insulation (Albany: Delmar Publishers, Inc., (1946)), passim.

[6] Walter E. Durbahn Fundamentals of Carpentry, Volume I, 4th Edition, (Chicago: American Technical Society, 1969), passim.

[7] Walter E. Durbahn and Elmer W. Sundberg Fundamentals of Carpentry Volume II, 4th Edition, (Chicago: American Technical Society, 1969), passim.

[8] Suggested Unit Course In: Concrete Form Construction (Albany Delmar Publishers, Inc., (1973)), passim.

[9] Willis Wagner Modern Carpentry (South Holland, Illinois: Goodheart-Wilcox Co., Inc., 1973), passim.

[10] The Use Of Hand Woodworking Tools (Albany: Delmar Publishers, Inc., 1973), passim.

[11] Suggested Unit Course In: Framing, Sheathing, and Insulation (Albany: Delmar Publishers, Inc., 1973), passim.

[12] Concrete Form op. cit., 1973.

[13]Hand Woodworking, op. cit.

[14]Framing, Sheathing, op. cit. 1973.

[15]Wagner, op. cit.

[16]Concrete Form, op. cit. (1946)

[17]Interior Exterior Trim, op. cit.

[18]Stair Layout, op cit.

[19]Framing, Sheathing, op. cit. (1946)

[20]Durbahn, op. cit.

[21]Durbahn and Sundberg, op. cit.

[22]Concrete Form, op. cit. (1973)

[23]Hand Woodworking, op. cit.

[24]Framing, Sheathing, op. cit. (1973).

[25]Wagner, op. cit.

[26]Interior, Exterior, op. cit. (1946)

[27]Durbahn, op. cit.

[28]Durbahn and Sundberg, op. cit.

[29]Stair Layout, op. cit.

[30]Framing, Sheathing, op. cit. (1946)

[31]Concrete Form, op. cit.(1946)

[32]John L. Feirer and Gilbert R. Hutchings Carpentry and Building Construction (Peoria: Chas. A. Bennett Co., Inc., 1976), passim.

[33]Finishing, op. cit.

[34]Wood, op. cit.

[35]Durbahn, op. cit.

[36]Durbahn and Sundberg, op. cit.

[37]Wagner, op. cit.

[38]"Comprehensive Examination In Carpentry," The University of the State of New York, The State Education Department, Parts I and II, June, 1977.

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary

This study has been a two-part examination of the readability of selected carpentry materials and the reading ability of 11th and 12th grade carpentry students with respect to the above materials. Its purpose was to determine whether 11th and 12th grade students of carpentry possess the reading skills necessary to comprehend the selected materials, representative of those materto be used in the field and classroom. To achieve that purpose, carpentry literature was subdivided into three categories: (1) materials installation instructions; (2) project instructions; and (3) classroom instructional literature. Samples of each of the three categories were analyzed by two readability analysis procedures to establish mean readability levels.

Having established the mean levels of reading skill necessary to comprehend literature pertaining to the three categories, samples at the mean were selected and clozed for testing. Cloze, the mutilation of test passages from the actual literature about which conclusions were to be drawn, was chosen as the instrument design, because of its use of actual instructional materials in

all three categories, rather than facsimile.

Two hundred seven passages were randomly selected from carpentry literature, projects and materials installation, and one hundred six passages from a control textbook. From these selections a clozed test was developed.

A sample population was selected from three facilities, of 92 students from twenty-seven school districts. The total enrollment in 1st and 2nd year laboratory carpentry classes, in attendance on the dates of testing, made up the sample. Ten textbooks used by the sample made up the basis of establishing the mean textbook readability level.

The subjects were tested during the last week of October, 1977, and the first week of November, 1977. The results of the tests were scored according to a frustrational, instructional, and independent level of reading ability. The 11th and 12th grade students' scores were compared to assess the impact of psychomotor skill training on the ability to read the literature.

Conclusions and Inferences

The range of readability of carpentry literature is first half fifth grade to college graduate, with 85.4% between second half seventh grade and the sixteenth year of school or college senior. It is bimodal at the eighth and thirteenth-to-sixteenth levels. The mean readability level lies at the ninth grade. It is sufficiently diverse to conclude that these materials have been prepared without consideration of achieving a uniform standard of

readability.

Both materials installation instructions and projects instructions cover a broad range of readability level and are bimodal, with projects modes at the seventh and the thirteenth-to-sixteenth grade levels.

Classroom instructional literature covers a readability range from first half sixth grade to tenth-to-eleventh grade levels. The Delmar Series are the lowest at the sixth to seventh grade levels; Modern Carpentry, the most difficult, at the 10th to 11th grade lev el; and Fundamentals of Carpentry I and II, lying between at the eighth and ninth grade levels.

The average readability of all texts was determined to be the seventh grade, primarily influenced by the use of seven Delmar Series texts of ten in the sample. Different combinations of texts caused each of the three facilities tested to require a different reading ability level: (1) low seventh at Facility One; (2) tenth to low eleventh at Facility Two; (3) high seventh at Facility Three.

Modular concept textbooks readability levels ranged from low ninth to low eleventh.

Review questions, in the texts containing them, ranged from one to three years lower in readability grade level and, in one case, one year higher.

None of the facilities tested offered a carpentry reading module or course. Only Facility One retained a reading diagnostic

test file on its students. All facilities reported that they did not believe the students able to read the texts or carpentry field literature. None reported a knowledge of readability levels by the instructors of their carpentry literature. Facilities One and Two had on file a study which evaluated certain carpentry instructional literatures. Facility Three indicated that the Delmare texts were used only by the instructor; Fundamentals in Carpentry, by the students, but rarely, de-emphasized, with psychomotor skills the primary teaching objective.

The test of reading ability used in this study was determined to be at the total readability level of low to middle eighth. At that level, none of the students scored at the frustrational level. Sixty-five percent scored at the high instructional, low independent, levels.

Comparison of mean scores on each test level at each facility demonstrated no appreciable difference between students according to facility. In all three cases, students scored slightly higher on the upper ninth grade materials and significantly higher on the mid-seventh grade materials, than on the lower ninth grade page of the test.

Comparison of the mean scores of the 11th and 12th grade students resulted in no appreciable difference. In fact, all but two of the means compared were higher for the 11th than for the 12th graders.

Because of the time frame of this study and its attendant limitations, most of its yield must be considered irferential. The

following conclusions can be drawn:

(1) At best, 11th and 12th grade carpentry students read carpentry literature at the instructional level, requiring supervision of translation to skill, or remediation to upgrade their average abilities;

(2) Carpentry literature readability is bi-modal, with a significant portion at levels beyond the abilities of its intended users;

(3) Classroom instructional literature readability is also bimodal with a significant portion at levels beyond the reading ability of its intended users;

(4) Procedures exist for both the determination of readability of carpentry literature and the assessment of students ability to read said literature;

(5) Psycho-motor skill training does not impact the ability to read the literature relevant to the skills being taught.

Several inferences can be drawn:

(1) Substantial numbers of materials manufacturers are not considering readability in the development of their literature;

(2) Projects literature publishers are, likewise, not considering readability;

(3) Classroom literature either does not equate with carpentry field literature or with the reading abilities of the students who use it. In the first instance, there is no attempt to require reading skill development; in the second, the material is of too high a reading level without attendant development;

(4) Carpentry courses are not designed to impact reading skill of students regarding the literature they will need to read in order to practice carpentry;

(5) Instructors are not assessing or requiring assessment of content area reading skills, nor attempting to develop or remediate them;

(6) Textbook review questions are not designed with consideration for readability;

(7) Readability and attendant reading ability have not been considered in the development of student manuals in modular conceptual education planning;

(8) Based upon reading skill, carpentry students will not be able to adapt to materials changes, changes in specifications, and the development of new projects installations methods;

(9) 11th and 12th grade carpentry students possess sufficient reading skills to be remediated or developed in their ability to comprehend carpentry literature;

(10) Niether general education nor vocational education is meeting its respective objective of providing carpentry students with sufficient skills to practice their chosen fields of endeavor.

Recommendations

Procedural research:

(1) Broaden the base of the study to increase the amounts of literature assessed and students tested;

(2) Conduct a comparison study between standardized diagnostic tests and cloze testing to further validate the use of the cloze procedure;

(3) Conduct a study of students at a given reading ability level, in terms of their results on a clozed test for additional validation;

(4) Conduct an item analysis of the correct and incorrect responses to the clozed test passages.

Procedural education:

(1) Establish a content reading skills assessment and training procedure for carpentry students;

(2) Assess classroom literature readability in terms of the present and anticipated abilities of the students;

(3) Provide teacher instruction in developing skills or remediating skills in content area reading;

(4) Coordinate the efforts of the vocational instructor and home school language arts, reading and English teachers;

(5) Strive to eliminate the stereotype that vocational students cannot read and the myth that psycho-motor skills will overcome reading deficits.

APPENDIX I
SOURCES: MATERIALS INSTALLATION INSTRUCTIONS
(Listed According To Sample Number)

Sample	Source
1.	Georgia Pacific (1939 3/73 M100 Skd)
2.	Hardwood Plywood Manufacturer's Association
3.	Montgomery Ward & Co., Inc. (74-41299 PR)
4.	Montgomery Ward & Co., Inc. (74-41299 PR)
5.	Montgomery Ward & Co., Inc. (74-24999 P)
6.	Montgomery Ward & Co., Inc. (74-28599 P)
7.	Montgomery Ward & Co., Inc. (74-28599 P)
8.	Montgomery Ward & Co., Inc. (74-28599 P)
9.	Minwax Co., Inc.
10.	Minwax Co., Inc.
11.	Andersen Corporation (350m, 1/76)
12.	Andersen Corporation (350m, 1/76)
13.	Andersen Corporation (350m, 1/76)
14.	Andersen Corporation (350m, 1/76)
15.	Andersen Corporation (350m, 1/76)
16.	Western Red Cedar Paneling, Council of Forest Industries of British Columbia
17.	Superior Fireplace Company (Form No. E21 - 72 - 50M)
18.	Superior Fireplace Company (Form No. E21 - 73 - 50M)
19.	Western Wood Moulding and Millwork Producers
20.	National Oak Flooring Manufacturer's Assn., (Form 322, 7/71)
21.	California Redwood Association
22.	Red Cedar Shingle and Handsplit Shake Bureau
23.	Montgomery Ward & Co., Inc. (74-21999 P)

APPENDIX I, continued
SOURCES: MATERIALS INSTALLATION INSTRUCTIONS
(Listed According To Sample Number)

Sample	Source
24.	Montgomery Ward & Co., Inc., (74-21999 P)
25.	Reinforced Plastics Division, Reichold Chemicals, Inc., NSA - 10 - 20 - 72)
26.	Montgomery Ward & Co., Inc. (No reference number)
27.	Montogmery Ward & Co., Inc., Descriptive Manual (MM-106)
28.	Montgomery Ward & Co., Inc., Descriptive Manual (TT-102)
29.	Montgomery Ward & Co., Inc., Descriptive Manual (MM-305)
30.	Montgomery Ward & Co., Inc., Descriptive Manual (LL-203)
31.	Certain-teed Products Corp. (Code No. 20-20-11-T)
32.	Certain-teed Products Corp. (Code No. 20-21-07-T)
33.	Certain-teed Products Corp. (Code No. 20-20-20-T)
34.	Certain-teed Products Corp. (Code No. 20-20-04-T)
35.	Z-Brick Company (Z-606)
36.	Z-Brick Company (Z-606)
37.	Red Cedar Shingle and Handsplit Shake Bureau
38.	Red Cedar Shingle and Handsplit Shake Bureau
39.	Rohm and Haas (PL - 1050)
40.	Rohm and Haas (PL - 1050)
41.	Rohm and Haas (PL - 1050)
42.	Rohm and Haas (PL - 1050)
43.	Filon Division of Vistron Corp., Form 152-4
44.	Filon Division of Vistron Corp., Form 152-4
45.	Alcoa Building Products, Inc. (5418-300M-6/70)
46.	American Brick and Stone Manufacturing Co.

APPENDIX I, continued
SOURCES: MATERIALS INSTALLATION INSTRUCTIONS
(Listed According To Sample Number)

Sample	Sources
47.	Woodbine Industries, Ltd.
48.	Armstrong (LA - 4006 - 1 71)
49.	William Wallace Division, Wallace-Murray Corp. (25-155-0173)
50.	William Wallace Division, Wallace-Murray Corp. (25-155-0173)
51.	William Wallace Division, Wallace-Murray Corp. (25-155-0173)
52.	Fabron Products, Inc. (No reference number)
53.	Storm Door Installation (No company reference name)
54.	Hardware Installation Instructions (No company reference)
55.	Roberts Division, Gabriel Industries (cpyrt MCMLXXIII)
56.	Assembly & Installation Instructions for Estate I Rolling Glass Doors (No company reference)
57.	Red Cedar Shingle and Handsplit Shake Bureau
58.	National Particleboard Association (No reference number)
59.	U.S. Dept. of Agriculture, Farmer's Bulletin No. 2227
60.	U.S. Dept. of Agriculture, Farmer's Bulletin No. 2227
61.	American Hardboard Association, Form No. P70
62.	American Hardboard Association, Form No. P70
63.	California Redwood Association (No reference number)
64.	California Redwood Association (No reference number)
65.	California Redwood Association (No reference number)
66.	American Hardboard Association, Form No. P70
67.	American Hardboard Association, Form No. P70

APPENDIX I, continued
SOURCES: MATERIALS INSTALLATION INSTRUCTIONS
(Listed According To Sample Number)

Sample	Sources
68.	American Hardboard Association, Form No. P70
69.	U.S. Department of Agriculture, Farmer's Bulletin 2227
70.	U.S. Department of Agriculture, Farmer's Bulletin 2227
71.	National Particleboard Association (No reference number)
72.	National Particleboard Association (No reference number)
73.	National Particleboard Association (No reference number)
74.	National Particleboard Association (No reference number)
75.	Filon Division of Vistron Corp., Form 152-4
76.	Red Cedar Shingle and Handsplit Shake Bureau
77.	Red Cedar Shingle and Handsplit Shake Bureau
78.	Montgomery Ward and Co., Inc. (74-2199 P)
79.	Montgomery Ward and Co., Inc. (74-2199 P)
80.	Red Cedar Shingle and Handsplit Shake Bureau
81.	Red Cedar Shingle and Hnadsplit Shake Bureau
82.	California Redwood Association (No reference number)
83.	California Redwood Association (No reference number)
84.	California Redwood Association (No reference number)
85.	California Redwood Association (No reference number)
86.	National Oak Flooring Manufacturer's Association, Form 322, 7/71)
87.	National Oak Flooring Manufacturer's Association Form 322, 7/71
88.	Superior Fireplace Company (Form EZ1 - 73 - 50M)
89.	Superior Fireplace Company (Form EZ1 - 73 - 50M)

APPENDIX I, continued
SOURCES: MATERIALS INSTALLATION INSTRUCTIONS
(Listed According To Sample Number)

Sample	Sources
90.	Western Red Cedar Paneling, Council of Forest Industries of British Columbia
91.	Western Red Cedar Paneling, Council of Forest Industries of British Columbia
92.	Western Red Cedar Paneling, Council of Forest Industries of British Columbia
93.	Minwax Co., Inc. (No reference number)
94.	Montgomery Ward and Co., Inc. (74-28599 P)
95.	Montgomery Ward and Co., Inc. (74-28599 P)
96.	Montgomery Ward and Co., Inc. (74-28599 P)
97.	Montgomery Ward and Co., Inc. (74-24999 P)
98.	Montgomery Ward and Co., Inc. (74-24999 P)
99.	Montgomery Ward and Co., Inc. (74-41299 PR)
100.	Georgia Pacific (1939 3/73 M100 Skd)
101.	Georgia Pacific (1939 3/73 M100 Skd)
102.	Georgia Pacific (1939 3/73 M100 Skd)
103.	Georgia Pacific (1939 3/73 M100 Skd)
104.	California Redwood Association (No reference number)
105.	Montgomery Ward and Co., Inc. (74-24999 P)

APPENDIX II
SOURCES: PROJECT ASSEMBLY/INSTALLATION INSTRUCTIONS
(Listed According To Sample Number)

Sample	Source
1.	U.S. Department of Agriculture, Home and Garden Bulletin Number 203
2.	U.S. Department of Agriculture, Home and Garden Bulletin Number 203
3.	U.S. Department of Agriculture, Home and Garden Bulletin Number 203
4.	Easi-bild Pattern Co., Inc. Number 606
5.	Easi-bild Pattern Co., Inc. Number 606
6.	Easi-bild Pattern Co., Inc. Number 606
7.	Easi-bild Pattern Co., Inc. Number 606
8.	Easi-bild Pattern Co., Inc. Number 606
9.	Easi-bild Pattern Co., Inc. Number 606
10.	Easi-bild Pattern Co., Inc. Number 606
11.	Easi-bild Pattern Co., Inc. Number 606
12.	Easi-bild Pattern Co., Inc. Number 606
13.	Stanley Tools, No Reference Number
14.	Stanley Tools, No Reference Number
15.	Stanley Tools, No Reference Number
16.	American Plywood Association (D370-172)
17.	American Plywood Association (D370-172)
18.	American Plywood Association (E390-172)
19.	American Plywood Association (E390-172)
20.	American Plywood Association (P180-272)
21.	American Plywood Association (P120-273)
22.	American Plywood Association (D80-1272)

APPENDIX II, continued
SOURCES: PROJECT ASSEMBLY/INSTALLATION INSTRUCTIONS
(Listed According To Sample Number)

Sample	Source
23.	American Plywood Association (G110-272)
24.	American Plywood Association (G110-272)
25.	American Plywood Association (G110-272)
26.	American Plywood Association (G110-272)
27.	American Plywood Association (G110-272)
28.	American Plywood Association (B410-1171)
29.	American Plywood Association (L20-1073)
30.	American Plywood Association (L20-1073)
31.	American Plywood Association (L20-1073)
32.	American Plywood Association (L20-1073)
33.	American Plywood Association (B420-1117)
34.	American Plywood Association (S630-472)
35.	U.S. Department of Agriculture, Leaflet Number 56
36.	U.S. Department of Agriculture, Leaflet Number 56
37.	U.S. Department of Agriculture, Leaflet Number 56
38.	U.S. Department of Agriculture, Leaflet Number 56
39.	U.S. Department of Agriculture, Leaflet Number 56
40.	Practical Builder, Data & Specification File, 4-15-58
41.	Easi-Bild Pattern Co., Inc. Number 696
42.	Easi-Bild Pattern Co., Inc. Number 696
43.	Easi-Bild Pattern Co., Inc. Number 696
44.	Easi-Bild Pattern Co., Inc. Number 696
45.	Easi-Bild Pattern Co., Inc. Number 696

APPENDIX II, continued
SOURCES: PROJECT ASSEMBLY/INSTALLATION INSTRUCTIONS
(Listed According To Sample Number)

Sample	Source
46.	Easi-Bild Pattern Co., Inc. Number 696
47.	Easi-Bild Pattern Co., Inc. Number 696
48.	Easi-Bild Pattern Co., Inc. Number 696
49.	Easi-Bild Pattern Co., Inc. Number 696
50.	Easi-Bild Pattern Co., Inc. Number 696
51.	Easi-Bild Pattern Co., Inc. Number 658/667
52.	Easi-Bild Pattern Co., Inc. Number 658/667
53.	Easi-Bild Pattern Co., Inc. Number 658/667
54.	Easi-Bild Pattern Co., Inc. Number 658/667
55.	Easi-Bild Pattern Co., Inc. Number 658/667
56.	Easi-Bild Pattern Co., Inc. Number 658/667
57.	Easi-Bild Pattern Co., Inc. Number 658/667
58.	Easi-Bild Pattern Co., Inc. Number 658/667
59.	Easi-Bild Pattern Co., Inc. Number 658/667
60.	U.S. Department of Agriculture, Farmer's Bulletin No. 1889
61.	U.S. Department of Agriculture, Farmer's Bulletin No. 1889
62.	U.S. Department of Agriculture, Farmer's Bulletin No. 1889
63.	U.S. Department of Agriculture, Farmer's Bulletin No. 1889
64.	U.S. Department of Agriculture, Farmer's Bulletin No. 1889
65.	Practical Builder Data & Specification File, 4-15-58
66.	Practical Builder Data & Specification File, 4-15-58
67.	Practical Builder Data & Specification File, 4-15-58
68.	Practical Builder Data & Specification File, 9-56

APPENDIX II, continued
SOURCES: PROJECT ASSEMBLY/INSTALLATION INSTRUCTIONS
(Listed According To Sample Number)

Sample	Source
69.	Practical Builder Data & Specification File, 3-62
70.	Practical Builder Data & Specification File, 3-62
71.	Practical Builder Data & Specification File, 4-15-58
72.	Practical Builder, May, 1962, page 112
73.	Practical Builder, May, 1962, page 99
74.	Practical Builder, May, 1962, page 50
75.	Practical Builder, May, 1963, page 171
76.	Practical Builder, May, 1963, page 94
77.	Practical Builder, May, 1963, page 142
78.	Practical Builder, May, 1963, page 132
79.	Practical Builder, May, 1963, page 130
80.	Practical Builder Data & Specification File, 4-15-58
81.	Practical Builder Data & Specification File, 4-15-58
82.	Practical Builder Data & Specification File, 4-15-58
83.	Practical Builder Data & Specification File, 4-15-58
84.	Practical Builder Data & Specification File, 4-15-58
85.	Universal Publishing & Distributing Corp., Copyright 1962
86.	Universal Publishing & Distributing Corp., Copyright 1962
87.	Universal Publishing & Distributing Corp., Copyright 1962
88.	Universal Publishing & Distributing Corp., Copyright 1962
89.	Universal Publishing & Distributing Corp., Copyright 1962
90.	Universal Publishing & Distributing Corp., Copyright 1962
91.	Red Cedar and Handsplit Shake Bureau

APPENDIX II, continued
SOURCES: PROJECT ASSEMBLY/INSTALLATION INSTRUCTIONS
(Listed According To Sample Number)

Sample	Source
92.	Red Cedar Shingle and Handsplit Shake Bureau
93.	Red Cedar Shingle and Handsplit Shake Bureau
94.	Red Cedar Shingle and Handsplit Shake Bureau
95.	Red Cedar Shingle and Hnadsplit Shake Bureau
96.	Practical Builder, September, 1955, page 137
97.	Practical Builder, December, 1960, page 72
98.	Practical Builder, December, 1960, page 73
99.	Practical Builder Data & Specification File, 4-15-58
100.	Practical Builder Data & Specification File, 4-15-58
101.	Practical Builder, May, 1963, page 88
102.	Practical Builder, May, 1962, page 101

APPENDIX III
NATIONAL APPRENTICESHIP AND TRAINING STANDARDS FOR THE TRADES OF CARPENTER, MILLWRIGHT, CABINETMAKER MILLMAN, AND OTHER SUBDIVISIONS

PREFACE

Set forth in the following pages is the latest revision of the National Apprenticeship and Training Standards for the trades of Carpenter, millwright, cabinetmaker millman, and other subdivisions of the trade. These programs have been jointly adopted by the United Brotherhood of Carpenters and Joiners of America, the Associated General Contractors of America, and the National Association of Home Builders of the United States. The standards were developed in cooperation with the Bureau of Apprenticeship and Training, U.S. Department of Labor.

These standards have been revised and expanded so as to encompass other essential and existing programs in the field of carpentry. Furhter, the standards provide for future expansion as new needs for training develop, by permitting the addition of a supplement to these standards when the supplement has been agreed to by the members of the National Joint Carpentry Apprenticeship and Training Committee.

It is hoped that contractors and labor representatives; members of local joint committees; and all those concerned with promoting fostering, and improving training for the preparation of skilled craftsmen for all branches of carpentry in every locality will take full advantage of these comprehensive, up-to-date national standards in their entirety, as a guide in the training of youth entering the

trade and for journeymen desirous of upgrading their skills.

The related instruction for apprentices must be taught by persons who recognize the value of good teaching techniques, and are thoroughly competent in the theory, practices, and skills of the appropriate branch of the carpentry trade.

The National Joint Carpentry Apprenticeship and Training Committee, recognizing problems encountered by local joint committees in formulating and establishing related instruction programs, suggests the topical outlines of related materials included herein as a minimum in all programs. No effort has been made, however, to segregate the materials for any given year of training. Therefore, each local committee must of necessity coordinate the related instruction with the on-job experience of the apprentice.

The national committee recommends that the Apprentice Training Manuals, prepared by the United Brotherhood of Carpenters and Joiners of America, be used as the core curriculum material for all related instruction. Where the use of other instructional materials may be considered necessary to supplement the course of instruction, thelocal committee should consult local public vocational school authorities for assistance in locating suitable text material and teaching aids to fit local needs.

Inquiries about the United Brotherhood of Carpenters and Joiners of America Apprentice Training Manuals should be directed to the Apprenticeship and Training Department, United Brotherhood of Carpenters and Joiners of America, 101 Constitution Avenue NW, Washington, D.C. 20001.

PURPOSE OF NATIONAL STANDARDS

Within the practice of the field of carpentry, there have been developed techniques and standards of workmanship that are of vital economic importance.

To assure their continuance in all branches of the field of carpentry, to give them more vitality, and to promote uniformity of practice (both interstate and local), National Apprenticeship and Training Standards for Carpentry have been formulated by the United Brotherhood of Carpenters and Joiners of America, The Associated General Contractors of American, Inc., and the National Association of Home Builders of the United States, with the assistance of the Bureau of Apprenticeship and Training, U.S. Department of Labor.

These national standards cover the basic requirements for effective apprenticeships and are offered for the guidance of local organizations of contractors and journeymen in the training of apprentices. They serve as a guide in establishing local systems of apprenticeship as well as in advancing and improving existing systems.

The national joint committee has endeavored to include in these revised national standards the most up-to-date concepts of training adopted. It is the intent of the committee to bring about greater uniformity of training and higher standards of efficiency and service for those entering all branches of the carpentry field, regardless of the locality of their training, than has been achieved in the past.

Further, the committee is endeavoring to encourage more journeymen to take advantage of the opportunities offered to improve their skills, to advance themselves in the newer techniques of their trade, and to keep abreast at all times of the advanced thinking in this field.

The committee would be remiss in its duty if it neglected to impress upon all local joint apprenticeship committees and members of local contractor's associations and carpenters' unions that they should give the closest study to the question of accident prevention and to encouraging safe working habits among apprentices.

The national committee recommends that all local joint carpentry apprenticeship committees include in their standards the provision that, in addition to the progressive wage percentage, apprentices are eligible for and shall receive the same fringe benefits provided journeymen under the local bargaining agreement. Further, wages and benefits shall be combined when establishing wage determinations for a given area.

(The National Joint Carpentry Apprenticeship and Training committee is made up of three members representing the Associated General Contractors of America, Inc.; two members representing the National Association of Home Builders of the United States; six members representing the United Brotherhood of Carpenters and Joiners of America; three Ex Officio Members of the Committee, one from each of the preceeding. The advisory agencies of the committee included the Bureau of Apprenticeship and Training, Manpower Administration, U.S. Department of Labor and the Division

of Vocational and Technical Education, U.S. Office of Education, Department of Health, Education and Welfare.)

APPENDIX IV
CARPENTRY CLASSROOM INSTRUCTIONAL MATERIALS

Durbahn, Walter E. Fundamentals of Carpentry, Volume 1, 4th Ed., Chicago: American Technical Society, 1969.

Durbahn, Walter E. and Sundberg, Elmer W. Fundamentals of Carpentry, Volume 2, 4th Ed., Chicago: American Technical Society, 1969.

Feirer, John L. and Hutchings, Gilbert R. Carpentry and Building Construction. Peoria: Chas. A. Bennett Co., Inc., 1976.
(Note: This textbook is a comprehensive carpentry textbook from which test passages were extracted; not a part of the text listing for the samples or basis of mean readability of sample textbooks.)

Finishing: Construction Industry Series Student Manual. Austin: Texas Education Agency, 1965.
(Note: This textbook is a sample of the modular concept instructional material; not a part of the text listing for the samples or basis of mean readability of sample textbooks.)

Suggested Unit Course In: Concrete Form Construction. Albany: Delmar Publishers, Inc., 1946.

_____. Albany: Delmar Publishers, Inc., 1973.

Suggested Unit Course In: Framing, Sheathing, and Insulation. Albany: Delmar Publishers, Inc., 1946.

_____. Albany: Delmar Publishers, Inc., 1973.

Suggested Unit Course In: Interior and Exterior Trim. Albany: Delmar Publishers, Inc., 1946.

Use of Hand Woodworking Tools, The. Albany: Delmar Publishers, Inc., 1973.

Wagner, Willis. Modern Carpentry. South Holland, Illinois: Goodheart-Wilcox Co., Inc., 1973.

Wilson, J. Douglas and Werner, S.O. Simplified Stair Layout. Albany: Delmar Publishers, Inc., 1947.

Wood: Construction Industry Series Student Manual. Austin: Texas Education Agency, 1975.

(Note: This textbook is a sample of the modular concept instructional material; not a part of the text listing for the samples or basis of mean readability of sample textbooks.)

APPENDIX V

The University of the State of New York
THE STATE EDUCATION DEPARTMENT

COMPREHENSIVE EXAMINATION IN CARPENTRY

June 1977
Part I

This examination consists of two parts. Each part counts 50 credits for a total of 100 credits for both parts. Both parts may be given on the same day in 3 hours, or the two parts may be given on different days for 1½ hours each day.

Time: 1½ hours

This part counts 50 credits. It must be completed in 1½ hours.

The use of a framing square is allowed.

The last page of the booklet is the answer sheet, which is perforated. Fold the last page along the perforations and then, slowly and carefully, tear off the answer sheet.

Fill in the heading of your answer sheet.

The answers to all questions in Group A are to be marked on the front of the answer sheet. The answers to the questions in Group B are to be written in the spaces provided on the back of the answer sheet.

Now open the test booklet, read the directions at the top of the first page, and begin work.

Group A

Answer all questions in this group.

Directions (1–70): For each statement or question, write on the separate answer sheet the *number* of the word or expression that, of those given, best completes the statement or answers the question. [35]

1 Which hand plane should be used to plane the edge of a long board?
1 jointer plane
2 rabbet plane
3 smoothing plane
4 block plane

2 Which should be used to lay out and check an angle of 75°?
1 a level
2 a T-square
3 a try-square
4 a miter gauge

3 Dowel holes can be more accurately made with the help of a
1 gimlet bit
2 drill gauge
3 doweling jig
4 dowel gauge

4 To make a deeper cut on the jointer, lower
1 both tables
2 the cutter head
3 the infeed table, only
4 the outfeed table, only

5 When large-diameter holes are bored with a variable speed drill,
1 rapid speed should be used
2 slow speed should be used
3 it makes no difference what speed is used
4 as much pressure as possible should be applied

6 Which hand power sander is *least* inclined to damage a veneer panel?
1 drum sander
2 belt sander
3 disc sander
4 orbital sander

7 If a hip roof has a unit rise of 8 inches and the rafters are spaced 16 inches on center, what is the difference in length between the first hip jack and the second hip jack? [Use a framing square to determine your answer.]
(1) $10\frac{7}{8}$ in
(2) $18\frac{7}{16}$ in
(3) $19\frac{1}{4}$ in
(4) $28\frac{7}{8}$ in

8 Which tool does the carpenter prefer for trimming and smoothing the edges of plastic laminates?
1 jack plane
2 electric router
3 smooth file
4 finishing sander

9 A story pole may be used to
1 lay out the handrails
2 support the stairway platform
3 support the treads
4 lay out the risers

10 When a radial arm saw is used for cross-cutting, the
1 work should be held firmly against the fence
2 antikickback fingers should be used
3 cutting is done on the backward stroke
4 blade must be reversed

11 The hazards of a protruding nail may be eliminated by
1 wearing rubber-soled shoes
2 removing or bending the nail
3 wearing safety shoes
4 wearing thick leather soles

12 When rabbets are cut on a jointer,
1 it is not necessary to wear safety glasses
2 the safety guard must be removed
3 the fence is tilted to a 45-degree angle
4 the rear outfeed table is lowered

13 Snap ties that are inserted in the form are tightened by
1 a wedge principle applied to the clamps
2 a ratchet wrench
3 twisting the loose ends
4 a screw

14 How many cubic yards of concrete are needed for a wall 18 inches thick, 4 feet high, and 18 feet long?
(1) $2\frac{1}{2}$ cu yd
(2) 5 cu yd
(3) 3 cu yd
(4) 4 cu yd

15 Where are expansion joints used?
1 screens
2 concrete work
3 parquet floors
4 oak floors

16 The horizontal member used to line up panels in form work is called a
1 stirrup
2 spreader
3 waler
4 brace

17 Most of the concrete forms that are built should be
1 aligned, only
2 aligned and braced, only
3 braced, only
4 aligned, braced, and plumbed

18 Snap ties are used to
1 keep the forms plumb
2 keep the forms from spreading
3 hold the walers
4 align the foundation wall

19 The depth of the footings and foundation is usually determined by the
1 frostline
2 available material
3 hardness of the soil
4 bearing partitions

20 The *minimum* bearing for a joist or a girder resting on a concrete foundation is
(1) 6 in
(2) 2 in
(3) 8 in
(4) 4 in

21 The metal cap placed on top of the foundation before the sill plate is called
1 the rain drip cap
2 a termite shield
3 a sill plate base
4 a water table

22 When snap ties are used, the two sides of the wall form are held the proper distance apart by
(1) 2-in × 3-in spreaders placed between the sheathing
(2) the washers on the ties
(3) cross bracing the form
(4) the screed boards at the side

23 Corners of a building are usually laid out and located by means of
1 base plates
2 line levels
3 batter boards and lines
4 framing squares

24 The purpose or function of footings is to
1 spread the load over a greater area
2 prevent water seepage
3 decrease the live load
4 concentrate the load at one point

25 The correct way to straighten a foundation wall before it is braced in position is to
1 use a plumb bob
2 use a level against the studs
3 take a sighting by eye
4 use blocks and extend a line the length of the wall

26 The most accurate way to plumb the corners of a foundation is to
1 use a large, homemade square
2 measure across the shoes, and then across the plates
3 use a plumb bob on a string
4 use a level

27 When grade stakes for a building footing are set, the leveling instrument should be set up
1 near the front of the building
2 near the rear of the building
3 in a central location
4 over the bench mark

28 An elevation of 104.5 feet is
(1) 4 ft 6 in above the bench mark
(2) 4 ft 5 in above the bench mark
(3) 104 ft 6 in above the bench mark
(4) 104 ft 5 in above the bench mark

29 If the right-triangle method is used to lay out a 90° corner, what will the diagonal measure if one side measures 9 feet and the other side measures 12 feet?
(1) 6 ft
(2) 8 ft
(3) 10 ft
(4) 15 ft

30 A step footing is most useful when
1 the ground slopes rapidly
2 the foundation is being built on loose fill
3 there is a drainage problem
4 the concrete must be poured at subzero temperatures

31 The simplest way to place a key in a footing is to
1 place a plain insert at the top of the footing
2 suspend a 2 × 4 in the form, level with the top
3 cut a groove in the "green" concrete with a small trowel
4 set anchor bolts in the footing

32 Which type of soil would have the greatest load-bearing capacity?
1 coarse sand
2 soft clay
3 gravel
4 fine sand

33 A partition blocking the end of a wall form is called a
1 bulkhead
2 strongback
3 screed
4 filler form

34 Anchor bolts are placed in a foundation to
1 tie the block wall to the footing
2 reinforce the footing
3 provide for expansion of the concrete
4 secure the wood sill to the wall

35 The *minimum* diameter in inches for anchor bolts used in house construction is

(1) $\frac{1}{4}$ (3) $\frac{1}{2}$

(2) $\frac{5}{16}$ (4) $\frac{3}{4}$

36 The riser board for concrete stair forms should be

1 lower than the treads
2 square at the bottom
3 higher than the treads
4 beveled at the bottom

37 The support for the floor joists of the second story in a balloon frame is called a

1 carriage 3 girder
2 ribbon 4 put log

38 When top plates are doubled, all joints at corners or over intersecting walls are

1 halved
2 spliced
3 lapped
4 the same as in the bottom plate

39 A put log is part of a

1 scaffold 3 stairwell
2 chimney 4 roof

40 How many F.B.M. (board feet) are in 42 floor joists measuring 2 inches × 10 inches × 14 feet long?

(1) 890 (3) 966
(2) 900 (4) 980

41 The lowest member of a partition is called a

1 heel 3 foot
2 shoe 4 seat

42 The rough opening for a 2–8 × 6–8 inside door would be

(1) 2 ft $8\frac{1}{2}$ in × 6 ft $8\frac{1}{2}$ in
(2) 2 ft $9\frac{1}{2}$ in × 6 ft $9\frac{1}{2}$ in
(3) 2 ft $10\frac{1}{2}$ in × 6 ft $10\frac{1}{2}$ in
(4) 2 ft $11\frac{1}{2}$ in × 6 ft $11\frac{1}{2}$ in

43 When a door opening with an r.o. width of $38\frac{1}{2}$ inches is framed, the length of the headers should be

(1) $38\frac{1}{2}$ in (3) $41\frac{1}{2}$ in

(2) 40 in (4) 43 in

44 Which sill construction is used in balloon framing?

(1) box sill (3) mud sill
(2) L-sill (4) T-sill

45 A distinguishing feature of western or platform framing is that the

1 first-floor studs rest on the sill
2 studs are continuous from the first floor to the second floor
3 floor and roof are framed with large beams spaced three feet or more o.c.
4 soleplate rests on the subfloor

46 When a built-up wood girder is constructed, all of the joints should be placed

1 over the columns
2 midway between the columns
3 at any convenient location between the columns
4 as close as possible to the floor openings

47 According to the FHA building requirements, framing members around a chimney should be

(1) tight against the chimney
(2) 2 in away from the chimney
(3) $\frac{1}{2}$ in away from the chimney
(4) anchored to the chimney with anchor bolts

48 The angle cut at the end of a floor joist that rests in a masonry wall is called a

1 fire cut 3 fire stop
2 chamfer 4 skewback

49 Which is the proper procedure for nailing cross bridging?

1 Nail both ends prior to laying the subfloor.
2 Nail both ends after laying the subfloor.
3 Leave the upper end loose until after laying the subfloor.
4 Leave the lower end loose until after laying the subfloor.

50 The r.o. size for framing a window can best be determined by

1 asking the owner
2 consulting the State building code
3 consulting the millwork catalog
4 simply adding $1\frac{1}{2}$ inches to the sash size

51 The number of board feet of 2-inch × 4-inch plate stock for the exterior walls of a building 28 feet × 40 feet would be

(1) 136 F.B.M. (3) 408 F.B.M.
(2) 272 F.B.M. (4) 816 F.B.M.

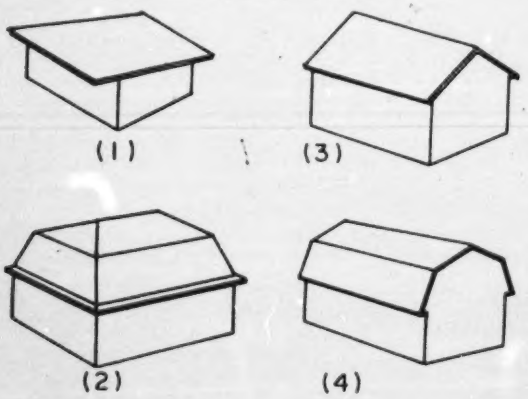
52 In order to allow for the installation of heating ducts, it is important that
1 the studs be placed directly above the joists
2 a fire cut be used on all floor joists
3 fire stops be placed every 4 ft
4 the sheathing be nailed with duplex nails

53 A sheathing material that is extremely rigid and provides a good nailing base is
1 gypsum board
2 plywood
3 fiberboard
4 styrofoam

54 When setting up a ladder, the carpenter should place it so that the distance from the bottom of the ladder to the building is
(1) $\frac{1}{4}$ the height of the building
(2) $\frac{1}{3}$ the height of the building
(3) $\frac{1}{2}$ the height of the building
(4) $\frac{3}{4}$ the height of the building

55 If a gable roof has a span of 32 feet and a rise of 10 feet 6 inches, how many square feet are in one gable end?
(1) 160 sq ft
(2) 165 sq ft
(3) 168 sq ft
(4) 336 sq ft

56 Which diagram shows a mansard roof?



57 The built-up section behind the chimney is called a
1 hip
2 dormer
3 cripple
4 cricket

58 The seat and heel cut forms a
1 bird's mouth
2 purlin
3 soffit
4 frieze

59 If a gable roof has a $\frac{3}{8}$ pitch and the gable end studs are spaced 16 inches on center, what is the common difference between two studs?
(1) 9 in
(2) 12 in
(3) 15 in
(4) 18 in

60 Which type of rafter touches neither the wallplate nor the ridge?
1 hip
2 jack
3 cripple
4 common

61 The pitch of a roof is calculated by figuring the
1 span over the rise
2 rise over the span
3 rise over the run
4 run over the rise

62 When a hip rafter is framed against the ridge, the shortening of the hip will be $\frac{1}{2}$ the 45° thickness of the
1 ridge
2 common rafter
3 hip rafter
4 side cut

63 Which numbers would be used on the tongue and blade to lay out a common rafter for a roof with a span of 30 feet and a $\frac{1}{4}$ pitch?
(1) 12 – 8
(2) 12 – 6
(3) 12 – 5
(4) 12 – 4

64 The overhang of a rafter is determined by the horizontal distance that it
1 drops below the plate
2 extends beyond the lot line
3 projects from the building
4 projects from the exterior finish

65 The run of a common rafter is equal to
(1) $\frac{1}{3}$ the rafter length
(2) the rise over the span
(3) $\frac{1}{2}$ the span
(4) $\frac{1}{2}$ the rise

66 Horizontal ties between rafters on opposite sides of the ridge and usually located in the upper half of the frame are called
1 collar beams
2 tail joists
3 jack rafters
4 cripples

67 The unit of run used for laying out the cuts on a hip or valley rafter is

(1) 9 in (3) 15 in
(2) 12 in (4) 17 in

68 Which can be determined if the diagonal of a square whose sides are equal to the overhang of a common rafter is known?

1 the length of a collar beam
2 the unit run of a valley rafter
3 the overhang of a hip rafter
4 the length of the first hip jack rafter

69 What kind of rafter should be either backed or dropped?

1 common rafter 3 valley jack rafter
2 cripple jack rafter 4 hip rafter

70 The lower horizontal framing member of a roof truss is called a

1 purlin 3 cripple
2 chord 4 collar beam

Group B

Answer all questions in this group. Each question counts 3 credits. Answers to the following questions should be written on the back of the answer sheet.

71 A carpenter replaced 60, 2-inch × 6-inch × 18-foot roof rafters. If the rafters cost $240.00 per M board feet, what was the replacement cost?

72 A 30- by 50-foot building is to be constructed.

a How many whole cubic yards of concrete will be needed for a 2-ft × 1-ft footing? [1½]

b How many whole cubic yards of concrete will be needed for the foundation walls if they are to be 10 feet high by 1 foot thick? [1½]

73 Determine the number of square feet of 1 × 3 D & M flooring required for a room 14 feet 6 inches × 20 feet 0 inches. Allow 40% for milling and waste.

74 Determine the stud length required to produce an 8-foot finish ceiling height for a house having platform framing, a $\frac{3}{4}$-inch finish floor, and a $\frac{1}{2}$-inch gypsum board ceiling.

75 If a hip roof has a span of 12 feet 0 inches and an overhang of 2 feet 0 inches, what is the total length of the hip rafter if the roof has $\frac{1}{4}$ pitch?

The University of the State of New York

THE STATE EDUCATION DEPARTMENT

COMPREHENSIVE EXAMINATION IN CARPENTRY

June 1977

Part II

Time: 1½ hours

This part counts 50 credits. It must be completed in 1½ hours.

The use of a framing square is allowed.

The last page of the booklet is the answer sheet, which is perforated. Fold the last page along the perforations and then, slowly and carefully, tear off the answer sheet.

Fill in the heading of your answer sheet.

The answers to all questions in Group C are to be marked on the front of the answer sheet. Answers to the questions in Group D are to be written in the spaces provided on the back of the answer sheet.

Now open the test booklet, read the directions at the top of the first page, and begin work.

Group C

Answer all questions in this group.

Directions (76–125): For each statement or question, write on the separate answer sheet the *number* of the word or expression that, of those given, best completes the statement or answers the question. [25]

76 The adjustment to compensate for sag in the lower chord of a roof truss is called
1 bulging
2 arching
3 camber
4 skewback

77 When strip sheathing for a wood shingle roof is installed, the strips should be spaced o.c. a distance equal to
1 the exposure of the shingles
2 the width of the sheathing material
3 half the length of the shingles
4 the average width of the shingles

78 Wood shingles are priced by the
1 board foot
2 yard
3 pound
4 square

79 The dividing members in a sash are called
1 stiles
2 rails
3 muntins
4 mullions

80 Rake fascia should be built out when the sidewall shingles are
1 single course
2 double course
3 nailed on first
4 to be installed later

81 The exterior beveled piece that extends across the lower part of a window unit is called the
1 sill
2 apron
3 stool
4 drip cap

82 Which type of fastener should be used to hold redwood beveled siding to the exterior of a wood structure?
1 G.D. common nail
2 an aluminum nail
3 a steel cut nail
4 a flathead wood screw

83 In order to prevent dry rot in structural members, a carpenter should
1 not use kiln-dried lumber
2 make all members vacuum tight
3 coat all members with paint
4 make sure all members are ventilated

84 The trim board that is placed on the plumb cut of the rafter ends is called the
1 frieze
2 fascia
3 plancier
4 rake

85 If the rough opening for a window is listed by the manufacturer as 3 feet 6 inches × 3 feet 5 inches, the height of the rough opening would be
(1) 3 ft 5 in
(2) 3 ft 6 in
(3) 3 ft 7 in
(4) 3 ft 8 in

86 What is the second step in the installation of an exterior door frame?
1 Level the sill.
2 Plumb the side jambs.
3 Place the frame in the r.o.
4 Nail the side jambs at the bottom.

87 A two-sash window unit that slides up and down in the window frame is called a
1 sliding unit
2 swinging unit
3 casement unit
4 double-hung unit

88 Which type of flashing is used where the dormer walls intersect the roof?
1 cap flashing
2 counter flashing
3 step flashing
4 pan flashing

89 When triple-tab, asphalt strip shingles are used under normal application, the minimum rise per foot would be
(1) 5
(2) 2
(3) 3
(4) 4

90 Why is diagonal subflooring preferred to subflooring that is square across the joists?
1 It does not require as much nailing.
2 It stiffens the floor.
3 It is easier to lay.
4 It is more economical to lay.

91 How far above the floor are closet poles placed in most clothes closets?
(1) 66 to 68 in
(2) 74 to 78 in
(3) 84 to 86 in
(4) 90 to 92 in

92 The tubular lock for a door would be set in the
1 stile
2 panel
3 jamb
4 rail

93 The primary purpose of a door jamb is to
1 cover up rough lumber
2 provide a place to fasten the casings
3 provide a square and plumb frame on which to hang the door
4 provide a place to anchor the doorstop

94 Which is the first operation when stool and apron window trim is installed?
1 nail the apron
2 fit the stool
3 miter the head casing
4 square cut the bottom of the side casing

95 Which construction material has the greatest insulating properties?
1 cinder block
2 aluminum
3 wood
4 common brick

96 Which door consists of two faced-panels with a built-in core?
1 flush door
2 panel door
3 louver door
4 folding door

97 The door jack is a device the carpenter makes in order to
1 wedge the door in the frame while it is being scribed or while the butts are being located on the jamb
2 hold the door, tools, and measuring rods in readiness for fitting and hanging
3 hold the door while planing the edges and fitting the hinges
4 mark and lay out the marks for the door hinges on both the door and the jamb

98 Which is the first step when installing a cylinder door lock?
1 Mark the door side for the spindle hole.
2 Bore a hole in the stile of the door.
3 Mark the location of the lock 36 inches from the floor.
4 Mark a vertical center line on the edge of the door.

99 In a double-hung window frame, the runway for the lower sash is formed on one side by the parting strip and on the other side by the
1 stool
2 apron
3 blind stop
4 stop bead

100 The trim member, usually $\frac{11}{16}$ inch × $3\frac{1}{2}$ inches, that extends beyond the sides of the window side-casing is called the
1 sill
2 stool
3 apron
4 jamb head

101 The joint that is best for interior corners because it does not open when nailing is the
1 miter joint
2 compound miter joint
3 butt joint
4 coped joint

102 In order to condition acoustical tile to the atmospheric conditions of the room prior to its installation, how long should the cartons be opened and allowed to stand?
(1) 4 hours
(2) 8 hours
(3) 24 hours
(4) 48 hours

103 The doors that give access to the entire closet opening but expose only half of it at one time are called
1 sliding doors
2 swinging doors
3 folding doors
4 bifold doors

104 When the double-layer method is used, the second layer of wallboard is fastened to the first by means of
1 sheetrock nails
2 rustproof screws
3 clips
4 adhesive

105 A bedroom contains 394 square feet of wall space. How many 4-foot × 8-foot sheets of wallboard are needed to cover the walls if 42 square feet is deducted for door and windows?
(1) 9
(2) 11
(3) 12
(4) 13

106 Before setting a cabinet in place in a corner that is *not* true and square, the carpenter should
1 reset and wedge out the wallboard
2 remodel the cabinet to fit the corner
3 scribe the side rail to the wall and to the floor
4 scribe the stile to the wall, with cabinet top set level

107 What is the average height of a hanging, kitchen wall-cabinet for a kitchen with an 8-foot ceiling?
(1) 30 to 32 in
(2) 34 to 36 in
(3) 40 to 42 in
(4) 46 to 48 in

108 Which type of stairway requires a landing?
1 quarter-turn winder
2 platform or dogleg
3 straight
4 circular

109 A simple, straight set of stairs has 14 risers. How many treads will be required?

(1) 13 (3) 15
(2) 14 (4) 16

110 In stair building, the term "dropping" is defined as the

1 riser board thickness cut off the bottom of the stringer
2 finished floor thickness cut off the bottom of the stringer
3 tread thickness cut off the bottom of the stringer
4 tread thickness added to the top riser

111 An open stringer is defined as one that is

1 left open under the stairs for storage
2 dadoed to receive the treads and risers
3 kerfed and formed for a set of winders
4 cut and mitered to receive the treads and risers

112 The distance that the tread extends past the face of the riser is a definition of

1 tread rise 3 tread run
2 tread projection 4 total run

113 The total rise of a stairway is equal to the distance from the

1 subfloor to the ceiling joist
2 finish floor to the finish ceiling
3 finish floor to the finish floor
4 first floor joist to the second floor joist

114 The three principal members of a balustrade are called

1 rails, balusters, and newels
2 treads, risers, and stringers
3 rise, run, and overhang
4 nosings, goosenecks, and volutes

115 Measured vertically at the front edge of the stair tread, the height to the top of the handrail should be

(1) 26 to 29 in (3) 34 to 37 in
(2) 30 to 33 in (4) 38 to 40 in

116 The total of one unit of run and one unit of rise for a main stairway should be

(1) 10 to 11 in (3) 14 to 15 in
(2) 12 to 13 in (4) 17 to 18 in

117 The minimum headroom for a main stairway as specified by FHA and other authorities is

(1) 5 ft 6 in (3) 7 ft 4 in
(2) 6 ft 8 in (4) 8 ft 1 in

118 The term "unit tread run" is defined as the

1 vertical distance from the first to the second floor
2 horizontal distance from the face of one riser to the face of the next
3 vertical distance from the top of one tread to the top of the next tread
4 horizontal distance from a point directly below the well opening to the face of the first riser

119 If the total rise of a stairway is 4 feet 8 inches and the height of each riser is 7 inches, the stairway must contain

(1) 6 risers (3) 8 risers
(2) 7 risers (4) 9 risers

120 If asphalt shingles are used to reroof over asphalt shingles, what length nail should be used?

(1) 1 in (3) $\frac{7}{8}$ in
(2) $\frac{3}{4}$ in (4) $1\frac{1}{4}$ in

121 When salvaging interior trim from remodeled old homes, existing nails should be

1 pulled out from the back side
2 pulled out from the face side
3 bent over
4 cut off

122 A carpenter was required to repair a roof area 18 feet × 25 feet. If the shingles selected came four bundles to the square, how many bundles would be needed?

(1) 12 (3) 18
(2) 16 (4) 20

123 Noisy or squeaking doorlocks should be lubricated with

(1) 3-in-1 oil (3) light grease
(2) graphite (4) SAE 10W–40 oil

124 During cold weather, condensation of water vapor in attic spaces usually indicates

1 inadequate insulation
2 poor construction
3 inadequate ventilation
4 a leak in the roof

125 Which type of ceiling consists of panels inserted in a metal grid?

1 sheetrock ceiling 3 asbestos tile ceiling
2 metal tile ceiling 4 suspended ceiling

Group D

Answer five questions in this group. Each question counts 5 credits. Be sure to answer every part of the five questions you choose. Answers to all questions in this group are to be written on the separate answer sheet.

126 For *each* use of a saw listed in parts *a* through *e*, write in the space provided on the answer sheet the *number* of the saw *chosen from the list below* that best fits that use.

Type of Saw

(1) Back saw
(2) Dovetail saw
(3) Hack saw
(4) Rip saw
(5) Crosscut saw
(6) Coping saw
(7) Compass saw

Uses

a A saw used to cut with the grain
b A saw used to cut across the grain
c A saw commonly used in a miter box
d A saw used to cut scrollwork on $\frac{3}{8}$" thick or less lumber
e A saw used to cut metal

127 For *each* size of angle listed in *a* through *e*, write in the space provided on the answer sheet the *number* of the description *chosen from the list below* that best fits that angle size.

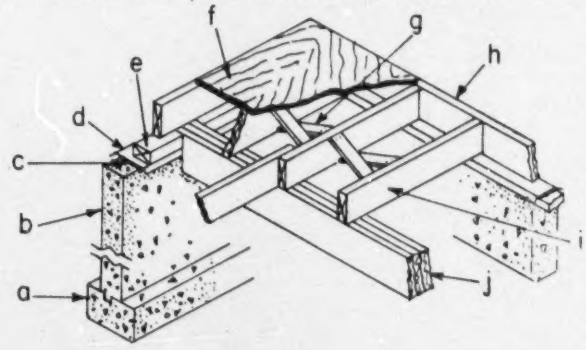
Descriptions

(1) Angle formed by a rip saw with the work
(2) Angle formed when scribing a complete circle with dividers
(3) The ground angle of a plane iron
(4) The largest angle that can be formed with a sliding-T
(5) Angle formed by a crosscut saw with the work
(6) Angle formed by blade and handle of a try-square

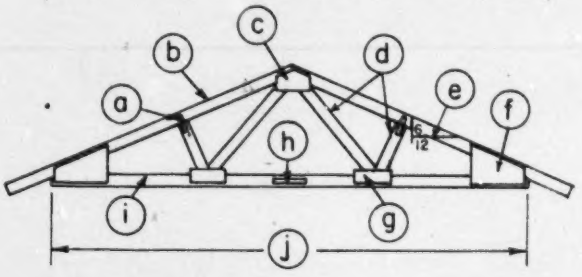
Angles

a 30°
b 45°
c 90°
d 180°
e 360°

128 For *each* part labeled *a* through *j* in the diagram below, write in the space provided on the separate answer sheet the *name* of each member.



129 For *each* part labeled *a* through *j* in the diagram below, write in the space provided on the separate answer sheet the *name* of each roof truss member.



130 List *five* different rafters and write a brief description of each in the space provided on the separate answer sheet.

131 A carpenter intends to construct a double-wall form without bulkheads for a concrete wall 12 inches thick, 10 feet high, and 40 feet long.

a How many lineal feet of plate stock will be needed? [1]

b If studs are placed 16 inches o.c., how many will be needed? [2]

c How many 4-foot × 8-foot sheets of Plyform will be required? [2]

☞ GO RIGHT ON TO THE NEXT PAGE.

132 Base your answers to questions *a* and *b* on the information below.

A house will use 1,440 square feet of roof shingles.

a If there are three bundles to a square, how many bundles will be needed? [2½]

b What is the total cost if the shingles are priced at $22.50 per square? [2½]

133 Base your answers to *a* through *c* on the information below.

A set of stairs measures 7 feet $8\frac{5}{8}$ inches from the top finished platform to the bottom finished floor. The run is 10 feet $4\frac{1}{2}$ inches.

a How many risers would be needed? [1]

b What would be the unit rise? [2]

c What would be the unit run of the treads? [2]

134 Base your answers to *a* through *d* on the information below.

A grid ceiling is to be installed in a 16-foot × 20-foot office. Main runners are available in 12-foot lengths, and wall angles are available in 10-foot lengths. The main runners run the length of the room.

a How many main runners will be needed? [1]

b How many wall angles will be needed? [1]

c How many 2-foot T's will be needed? [1]

d How many 2-foot × 4-foot ceiling tiles will be needed? [2]

BIBLIOGRAPHY

Bennett, James G. and Muncrief, Martha C., eds. Instructional Materials For Occupational Education. Ithaca: Cornell Institute For Research and Development In Occupational Education, 1975.

Brann, Donald. Roofing Simplified. Briarcliff Manor, N.Y.: Directions Simplified, Inc., 1974.

Coleman, Edmund B. "Developing A Technology of Written Instruction: Some Determiners of The Complexity of Prose. In E.Z. Rothkoph and P.E. Johnson (Eds.). Verbal Learning Research and The Technology of Written Instruction. New York: Teachers College Press, Columbia University, 1971. Cited by Klare, George R. "Assessing Readability." Reading Research Quarterly. Volume 10, (November, 1974).

"Comprehensive Examination In Carpentry." The University of The State of New York, The State Education Department. Parts I and II, June, 1977.

Crane, L.D. "Levels of Structural Difficulty in Language and Readability." Dissertation Abstracts. Volume 24 (1963), p. 1746. Cited by Klare, George, supra, 1974.

Dale, Edgar and Chall, Jeanne S. "A Formula For Predicting Readability." Educational Research Bulletin. 27 (January 21 and February 17, 1948.) pp. 11-20, 37-54.

Durbahn, Walter E. Fundamentals of Carpentry. Volume I, 4th Ed., Chicago: American Technical Society, 1969.

Durbahn, Walter E. and Sundberg, Elmer W. Fundamentals of Carpentry. Volume II, 4th Edition. Chicago: American Technical Society, 1969.

Farr, James N., Jenkins, James J., and Paterson, Donald G. "Simplification of Flesh Reading Ease Formula." Journal of Applied Psychology. 35 (October, 1951).

Feirer, John L. and Hutchings, Gilbert R. Carpentry and Building Construction. Peoria, Illinois: Chas. A. Bennett Co., Inc., 1976.

Finishing - Construction Industry Series Student Manual. Austin, Texas: Texas Education Agency, 1975.

Flesh, Rudolph. The Art Of Readable Writing. New York: Harper & Brothers, 1949.

Fry, Edgar B. "A Readability Formula That Saves Time." Journal of Reading. 11 (April, 1968) pp. 513-16, 675-78.

Gunning, Robert. The Techniques of Clear Writing. New York: McGraw-Hill, 1952; revised edition, 1968.

Holmquist, John B. "A Determination of Whether The Dale-Chall Readability Formula May Be Revised To Evaluate More Validly The Readability of High School Science Materials." Unpublished Doctoral Dissertation. Colorado State University. 1968. In Dissertation Abstracts. 29 (1968) p.407A. Cited by Klare, George R. supra, 1974.

"How To Install Particleboard Floor Underlayment." National Particleboard Association. Silver Spring, Maryland.

Jacobson, Milton D. "Reading Difficulty of Physics and Chemistry Textbooks In Use In Minnesota." Unpublished Doctoral Dissertation. University of Minnesota, 1961. In Dissertation Abstracts. 22 (1962) p. 3950. Cited by Klare, George R. supra, 1974.

Klare, George R. "Assessing Readability." Reading Research Quarterly. Volume 10. (November, 1974).

Levin, B.J. "Reading Requirements For Satisfactory Careers." Reading and Career Education. Perspectives In Reading No. 19. Nielsen, Donal M. and Hjelm, Howard F., (eds.) Delaware: International Reading Association, 1975.

"National Apprenticeship and Training Standards." National Joint Carpentry Apprenticeship and Training Committee. Washington, D.C. Superintendent of Documents.

Rankin, Earl F. "The Cloze Procedure--Its Validity and Utility." Measurement and Evaluation of Reading. Farr, Roger. (Ed.) New York: Harcourt, Brace, and World, Inc., 1970.

Shaw, Robert Arley. "Criterion and Independent Variables and the Precision Indexes of These Variables As Used In Establishing A Formula For Predicting Reading Difficulty of Programmed Materials In Fourth Grade Science." Unpublished Doctoral Dissertation. University of Virginia. 1967. In Dissertation Abstracts. 28 (1968) pp. 3572A, 3573A. Cited by Klare, George R. supra, 1974.

Smith, A.D.W. Generic Skills For Occupational Training. Prince Albert, Saskatchewan: Training and Research Developement Station, 1973. In Sticht, Thomas and McCann, Howard H. "Reading Requirements For Career Entry." Reading And Career Education. Delaware: International Reading Association, 1975.

Spache, George. "A New Readability Formula For Primary Grade Reading Materials." Elementary School Journal. 53 (March, 1953) pp. 410-13.

Suggested Unit Course In: Concrete Form Construction. Albany: Delmar Publishers, Inc. (1946 and 1973).

Suggested Unit Course In: Framing, Sheathing and Insulation. Albany: Delmar Publishers, Inc. (1946 and 1973).

Suggested Unit Course In Interior and Exterior Trim. Albany: Delmar Publishers, Inc. (1946 and 1975)

Taylor, W.L. "Cloze Procedure: A New Tool For Measuring Readability." Journalism Quarterly. 30 (Fall, 1953). Cited by Farr, supra.

Use Of Hand Woodworking Tools, The. Albany: Delmar Publishers, Inc. 1973.

Wagner, Willis H. Modern Carpentry. South Holland, Illinois: Goodheart-Wilcox Co., Inc., 1973.

Wilson, J. Douglas and Werner, S.O. Simplified Stair Layout. Albany: Delmar Publishers, Inc., (1947).

Wood - Construction Industry Series Student Manual. Austin, Texas: Texas Education Agency, 1975.